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Chimneys: Their Design and Construction

I. Common Chimney Faults.

By HAROLD L. ALT.

Chimneys are one of the oldest and most useful inventions conceived by man. They are of greater and more fundamental importance than anything that any modern inventor has contrived. In a primitive form they are almost as old as the human race, for a fire could not be made to burn with any regularity, nor the smoke kept from being a nuisance, without a draft. The first chimneys were probably natural crevices in the rocks forming the walls and roofs of caverns which were used for human habitation at that period.

Later stones were piled together to form rude chimneys somewhat as a camper piles them to-day to cook his food. Indian wigwams were commonly turned into very smoky and ineffective chimneys during cold weather by making an opening at the apex of the tent and lighting a fire on the ground in the center.

It takes engineering ability to make a good chimney, and one must understand the laws of Nature which apply to their construction and operation. Modern factory chimneys are triumphs of scientific construction, being built tall in order to maintain a large, hot fire, and the heated air and gases pour up through some of them with the velocity of a small hurricane at the rate of thirty-five to forty miles an hour.

Each one of us is directly affected by the sizes of the chimneys used in the world to-day, many of the trials and tribulations of our journey through this vale of tears being directly traceable to them. This, however, is not so much the fault of the chimneys as it is of the persons who build them and either deliberately transgress Natures laws or are largely ignorant of them.

MOST COMMON ERROR IN CHIMNEY WORK.

The most common error made in regard to chimneys is that of not distinguishing between the size (which governs the volume of smoke they can handle) and the height (which determines the intensity of the draft). A chimney may be *high* enough yet with an *area* too *small* to do the work required. On the other hand it may be *large* enough but too *low* to produce a *draft* of the strength required to pull the air through the fire and up the chimney at a sufficiently rapid rate. Either fault, or a combination of both, will result in unsatisfactory service and will require remedying.

BASIC PRINCIPLE INVOLVED.

The easiest way to understand the

operation of a chimney is to consider the great laws of Nature governing its operation—for there is, indeed, nothing so very mysterious about the process. The same force which supports the toy balloon and operates the hot air furnace causes the draft in the chimney. This is the simple fact that heated air expands and occupies a greater volume than the other air of a lesser temperature. Therefore, if a cubic foot of air outside the chimney weighs 0.07 lbs. and a cubic foot of the chimney gases at their higher temperature weighs only 0.04 pounds then every vertical foot of air in the chimney means an unbalanced pressure of 0.07 — 0.04 or 0.03 lbs. per square foot at the base. This unbalanced pressure has a tendency to equalize by the rising of the lighter gases, but, since their place is taken by more heated gases coming directly from the fire, the temperature, of course, never does equalize and the action continues its operation as long as the fire is kept burning.

From this basic principle all chimney action is governed and many chimney failings can be explained. For instance —the draft of a chimney is never as good in summer as in winter—because the outside air is colder in winter, the expansion of the chimney gases at the same temperature is therefore relatively greater and the intensity of the chimney draft is consequently increased.

It is a well-known trouble with chimneys that when out of use for any considerable period trouble is likely to be experienced in "starting the draft." This is easily explained by the fact that, in starting, the cold chimney will cool off the gases to a point where their temperature may be the same, or nearly the same, as the outside air, thus causing them to contract and lose their buoyancy. This, of course, immediately results in killing the draft, as the draft depends absolutely on a temperature difference and the expansion resulting therefrom.

Ordinary residence chimneys have little trouble on account of height owing to the fact that most residence heating systems burn large size anthricite coal which makes a very hot clear fire and offers little resistance to the passage of air through the fire bed. In fact, many of the older railroad stations and similar places use coal stoves with only a stove pipe extended through the roof, this pipe seldom being over 10 ft. in height. But an attempt to burn smaller sizes such as pea and buckwheat would be doomed to failure under such conditions.

The ordinary residence usually employs a chimney between 25 and 60 ft. high, the area being proportional to the size of the house and it is interesting to note that it is possible to burn No. 1 buckwheat coal with a chimney 55 ft. high if the fire bed is not made too thick. Down-draft boilers should have chimneys at least 60 ft. high to operate successfully.

COMMON CHIMNEY TROUBLES.

The more common troubles may be summarized as

(*a*) Chimney of bad shape—not approximately square or round, or with too many offsets.
(*b*) Too small a chimney.
(*c*) Too low a chimney.
(*d*) A combination of (*a*), (*b*) or (*c*).
(*e*) Too much leakage.
(*f*) Downdrafts.
(*g*) Lack of air supply for fire.
(*h*) Loose connections to chimney.
(*i*) More than one smoke pipe connected.
(*j*) Stoppage in offsets.
(*k*) Inserting smoke pipe too far into chimney.

Chimneys have to overcome their own losses, these losses consisting of the friction of the gases rubbing against the sides in their upward passage. For this reason a *circular-shaped flue* is most desirable, there being less surface exposed in comparison to the area than in any other shape. Most high stacks where the friction builds up to a considerable amount are, therefore, made round in cross section.

The next most advantageous shape is *square* and the next, after that, is *oblong* with the *long* side *not more* than *double* the length of the *short* side. In flues where it is necessary to exceed this proportion *two* separate flues of more desirable shape can sometimes be used with advantage.

With the same idea of reducing the friction of the gases on the sides it is most desirable to build a chimney flue *straight* from top to bottom as all changes in direction, or even in shape, produce an additional friction loss, as does also the condition of the interior surface. The *smoother* the surface the *less* the *rubbing* effect and for this reason the use of flue tile is advocated, this being tile flue pipe made in various forms and shapes and with a very *smooth* interior surface. Fig. 1 shows a plain brick chimney without tile and Fig. 2 the construction of a chimney using flue tile.

From the above it can be seen that *the most efficient chimney, as far as draft is concerned, is one built perfectly straight from the bottom up, round (or nearly round) in the shape of the interior flue, and lined with tile, or with the interior surface made as smooth as possible by other means.* There is no advantage in tapering the inside of a chimney to a smaller size toward the top as this retards the flow of the gases.

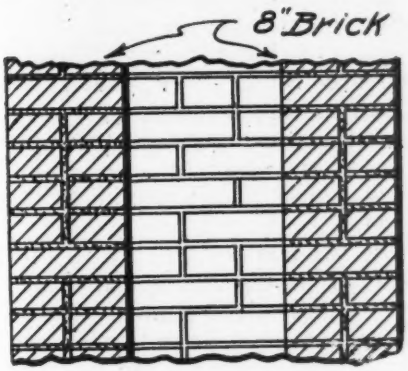


FIG. 1—PLAIN BRICK CHIMNEY WITHOUT TILE.

Having a chimney built upon desirable lines, as far as draft is concerned, it may, of course, still be too small, and in this connection it might be said that no flue should be made *less* than 8 in. diameter or 8 in. x 8 in. square. Under ordinary conditions, with steam, furnace or hot water heating, the sizes of flues given in Table I will be found to give satisfaction in residences whose cubic footage does not exceed the amounts shown.

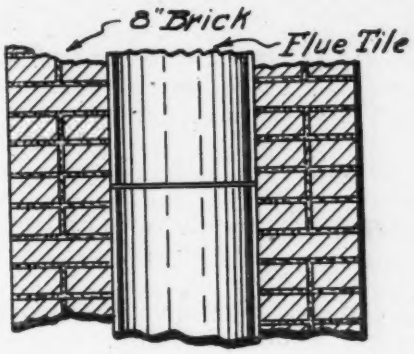


FIG. 2—CHIMNEY WITH FLUE TILE.

When flue tile is used the interior dimensions are not in even figures, the exact dimensions of commercial sizes being given in Table II.

When square or rectangular chimneys are designed for fire-places which burn wood or bituminous coal they are usually made with an area of 10% to 12% of the fire-place opening, while with round flues the area may be reduced to 8%. For anthracite coal the rectangular or square flue may be reduced to 8% and the round flue to 6%. Ordinary stoves are readily served with an 8 in. x 8 in. flue provided no other connections are made to it.

All chimney walls should be 8 in. thick to avoid danger of fire from sparks working through the joints and the building laws in some cases demand not only 8 in. thick walls but tile linings as well.

TABLE I—SIZES OF FLUES FOR RESIDENCES.

Contents of Building Cubic Feet	Round Inches Diameter	Square Inches	Oblong Inches
20,000	8	8 x 8	6 x 10
40,000	9	9 x 9	8 x 12
60,000	10	10 x 10	8 x 14
110,000	12	12 x 12	10 x 18
120,000	14	14 x 14	12 x 18
130,000	16	16 x 16	12 x 18
150,000	18	18 x 18	14 x 20

TABLE II—COMMERCIAL SIZES AND AREAS OF FLUE TILE.

Square or Oblong Outside Dimensions Inches	Circular Inside Dimensions Inches	Area Sq. In.
..	8	50
8½x8½	..	52
..	9	64
..	10	78
8½x13½	..	80
..	11	95
..	12	113
13x13	..	126
..	13	133
13x18	14	154
..	..	169
..	15	177
..	16	201
..	17	227
18x18	..	240

ADDITIONAL ADVANTAGES OF ROUND CHIMNEYS.

There are also other advantages in building chimneys round (or nearly round) and in the use of flue tile. The gases in their progress upward do not move in a straight line but assume a swirling, spiral motion resembling the rifling of a gun barrel and in the process of aiding this movement a circular shape is best.

In fact, a *square* chimney can hardly be figured as having its full area effective, a *deduction of 10% to 15%* being necessary on account of this very movement leaving the corners dead and inactive. In an *oblong* shape the effect is worse, a *deduction of 25%* being none too much. The use of tile flues will not only aid this slightly—owing to their rounded corners—but will also safeguard much of the fire risk otherwise due to mortar falling out between the bricks as time passes and leaving openings through which a spark might pass. As the tile serves to retain the gases and smoke it also prevents leakage which can spoil a chimney action at any time, no matter how perfectly the flue may otherwise be built.

The *height* of residence chimneys, as before mentioned, is not so important where the larger sizes of anthracite coal are used. The draft, however, ought to approximate in *inches of water* the various values given in Table II-A after being in use twenty-four hours and with all the inlets suddenly closed.

The figures given are about 90% efficiency of the theoretical draft which an absolutely tight chimney would show and a properly constructed chimney should approximate these figures.

METHOD OF USING DRAFT GAUGE.

Measurement of the draft in a chimney is made by a draft gauge which in its simplest form is nothing but a glass tube of U-shape, one end of which is connected to the base of the chimney and the other end is left open to the air.

The suction or draft of the chimney will raise water placed in the tube so

TABLE II-A—DRAFT IN CHIMNEYS FOR RESIDENCES.

	Temperature of Chimney Gases, Deg. F.		
Height in Feet	200	250	300
	Inches of Water		
60	0.27	0.32	0.35
55	0.25	0.29	0.32
50	0.23	0.26	0.29
45	0.21	0.23	0.26
40	0.18	0.21	0.23
35	0.16	0.19	0.20
30	0.14	0.16	0.17
25	0.12	0.14	0.14
20	0.09	0.11	0.12

that the water in the leg connected to the chimney stands higher than that in the leg open to the atmosphere, this being due to the unbalanced pressure and proportional thereto. The difference in level between the two columns of water is measured in inches, this difference being termed the draft in "inches of water." Some draft gauges have the legs of the U inclined only a few degrees off the horizontal so that a rise of a small amount causes a large movement horizontally along the inclined tube on which finer graduations can be read.

To take a theoretical draft reading (which is the most accurate method to pursue) see that the temperature of the flue gases is known at the time of taking the reading and that a tight damper can be closed in the smoke pipe. Connect the draft gauge to the chimney, take the flue gas temperature and then quickly close the smoke pipe damper and read the draft gauge as soon as it reaches the highest fixed point.

For points above sea level the readings will be *less* than that shown in the table the percentages being for

2,000	feet,	97%
4,000	"	94%
6,000	"	92%
8,000	"	89%
10,000	"	86%

Thus, a chimney 50 ft. high and at 250° temperature at sea level should have a draft of 0.26 in., but at 6,000 ft. elevation it should have 0.26 x 92%, or 0.24.

CHIMNEY LEAKAGE.

Leakage may take place not only *through the joints* of the chimney itself but through the *connections to the chimney.* For this reason a *separate* chimney flue for every connection is advocated.

A stove on the first floor and a heating apparatus in the basement may be connected to the same flue, *if it is large enough,* and both may work satisfactorily; but put out the fire in the stove and open the doors—the inrush of cold air into the flue will *spoil the draft* for the heating apparatus, this inrush of air being simply excessive leakage into the flue all at one point.

The *leakage* may not even come from the outside air but *may come from an adjoining flue* in which case it is just as detrimental in its effect. For this reason chimneys with more than one flue should never be built without *a 4-in. brick wall between the flue tiles.* The common practice of placing flue tile close together *without this brick wall later leads to trouble* in many chimneys.

Several boilers may be connected into one flue of sufficient size if they all are properly dampered in the smoke pipe with tight dampers and if these dampers are kept closed when the boilers are out of commission.

USE OF TWO FLUES FOR ONE APPARATUS.

Questions are often asked about using two old flues for one apparatus when it is desired to make alterations in an existing building. In this regard it can be said that reasonably satisfactory operation can be secured from such an installation if the dividing partition is knocked out 5 or 6 ft. down from the top of the chimney and up to 5 or 6 ft. above the point where the smoke pipe enters the chimney. There must be no other connections to the chimney, however, and the chimney must be in good condition otherwise to serve its purpose; the best results will be obtained where the smoke pipe enters the middle of the enlarged chimney so as to distribute the hot gases as equally as possible into both flues higher up. Of course, the center partition remaining exposes just so much more rubbing surface to the gases, giving a greater friction loss and the chimney will give better service—otherwise a stronger draft if the center partition is removed entirely.

OTHER CHIMNEY DEFECTS.

Oftentimes chimney troubles are entirely due to outside causes and not to the construction of the chimney itself. The most frequent of these is the *termination of a chimney below the level* of the adjacent ridge of the roof or other nearby obstruction. Even nearby buildings or mountains may interfere

with the operation of a chimney, the cause in all cases being the wind coming over the higher obstruction and dropping down onto the top of the chimney. As can be easily realized, chimney draft (after deducting the friction in the chimney, in the heating apparatus, and in the fire and smoke pipe) does not possess a very great force, and a high wind, with the air dropping down toward the top of the chimney, could readily hold back the action and, in some cases, even result in "back-drafts."

The best *remedy* for such trouble is to *extend* the chimney higher so as to get *above* the nearby ridge or building if possible. This at the same time will both prevent the wind dropping down onto the top of the chimney and will give the chimney (due to the increase of its height) a stronger draft to resist such action. If this is impractical one of the *many types of chimney tops* having side or downward outlets *will prevent "back-drafts"* but these will at

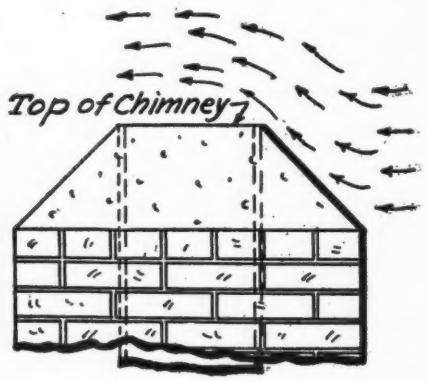


FIG. 3—GOOD TYPE OF CHIMNEY TOP.

the same time slightly retard the chimney action, due to the greater number of turns the gases are forced to make and the additional friction thus produced.

A very *desirable type of chimney top,* where "down-drafts" are not likely to be encountered, consists of finishing off the *top at a 45% angle* all around from the flue outlet to the side of the chimney, as shown in Fig. 3. This results in deflecting horizontal winds upward when blowing across the top of the chimney and gives a slight ejector action, helping to draw the gases up and out of the chimney.

Trouble with a chimney may also be

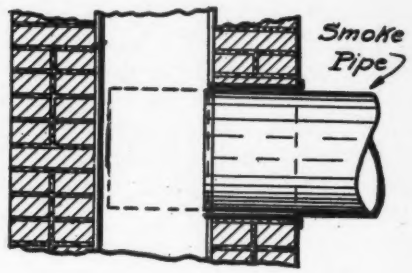


FIG. 4—HOW CHIMNEY AREA MAY BE RESTRICTED BY SMOKE PIPE.

experienced on certain days when the cellar door comes on the *leeside* of the building or when the cellar is so *air tight* that sufficient air does not leak in to replace that lost up the chimney. This results in a *partial vacuum* in the cellar which vacuum reacts against the draft that would otherwise be obtained. The remedy for this is to *open a cellar window on the windward side, close the opening to the leeward,* or else *provide some means of allowing air to enter* from some other source where the wind action is not encountered.

The connection to the chimney commonly termed the *smoke pipe* is another factor which must be considered. The smoke pipe should *never be reduced below the size of that on the heating apparatus;* if more than one smoke pipe is connected into a common pipe before going into the chimney the area of the *common pipe* should have an *area equal to* the *combined areas* of the two entering pipes. A loose connection where the pipe enters the chimney, a loose fitting cleanout door or other openings leading into the chimney will act the same as a leakage from any other source.

Neither should the smoke pipe be shoved into the chimney so far as to *project into the interior opening* as shown in dotted lines—Fig. 4—since this restricts the area and if carried to an extreme will shut off the draft entirely. Every smoke pipe should have a *tight damper* operated by hand for closing down during high winds, for testing and for use when the apparatus is out of service.

Chimneys which have given good serv-

ice for years and which then gradually fail to have sufficient draft usually are found to need *cleaning* and chimneys with *offsets at a sharp angle* are usually troubled in this way. A cobble stone tied to a rope and dropped down gradually from the top of the chimney, working this up and down as it goes down, will clean out many such troubles at slight expense. Gun powder in small charges ignited in the base of the chimney has also been used to jar the soot loose but this method does not come within the "safety first" limitations.

Next month the author will take up designing data for chimneys and power plant stacks. His discussion will be accompanied by friction loss charts for brick and steel stacks and a theoretical draft chart for stacks.

Remodeling the Ventilation of a Theatre

Changes Made to Overcome Overheating, Local Cold Drafts and Unsatisfactory Ventilation.

By SAMUEL R. LEWIS.

(*Presented at the annual meeting of The American Society of Heating and Ventilating Engineers, New York, January* 16-18, 1917.)

The purpose of this paper is to describe some experiences with the heating and ventilating of a very large theatre. The original plant was not satisfactory. It was changed at slight expense into a very satisfactory system by performing a comparatively small amount of labor.

The theatre is used mainly for concert purposes, being the home of an endowed orchestra. As originally installed, the plant was arranged for downward ventilation. The fresh air, taken from a point about 20 ft. above the ground, was warmed to prevent freezing, drawn through an air washer and tempering heaters to a fan, and then under pressure was delivered through an underground masonry tunnel, as shown in Fig. 1, to reheaters placed approximately under the center of the auditorium. These reheaters were placed in connection with plenum chambers in such a way that single metal ducts provided with automatic double mixing dampers, radiated from them, leading to the various flues placed around the walls. The mixing dampers in these ducts were controlled by thermostats placed in the auditorium. The air was to be removed through approximately 800 5-in. floor tubes through the first floor, which connected into chambers formed by the concrete first floor as a ceiling, the circumferential floor beams as sides and the galvanized steel bottom. These chambers, at each side of the basement, connected with metal ducts to two large vent flues, one at each end of the stage, running from the basement to the exhaust fan chamber in the attic. The illustration, Fig. 1, which is a center line section, shows the location of the inlets and outlets as follows:

Flues A: One of these is placed at each side of the stage, runs to the attic and across the attic to the rear of the house. Each has openings as follows: at A, 10 ft. above the lowest point of the first floor; at A-1, opposite the balcony, and at A-2 where each duct supplies two openings discharging diagonally through the ceiling over the gallery.

Flues B: Two on each side under the balcony discharging toward the center of the house.

Flues C: One on each side under the balcony discharging toward the stage.

Flues D: Two on each side underneath

the gallery, discharging toward the center of the house.

Flues E: One on each side under the gallery discharging toward the stage.

It will be seen that the air delivered through E strikes the beam and is deflected toward the floor. There were six large grilles around the chandeliers in the ceiling. These were connected with metal ducts to the exhaust fan and had a cross connection to the two ducts A so that the ceiling openings could be used for either supply or exhaust air.

The exhaust fan discharged into a masonry flue provided with a pneumatically-operated damper which was intended to prevent the escape of heated air when the auditorium was unoccupied.

The very tortuous duct systems in the basement and attic, comprising both fresh- and foul-air conveyors presented a very complicated appearance, and caused a very heavy frictional resistance. Very little heating effect was apparent when operating the plant without running the fans.

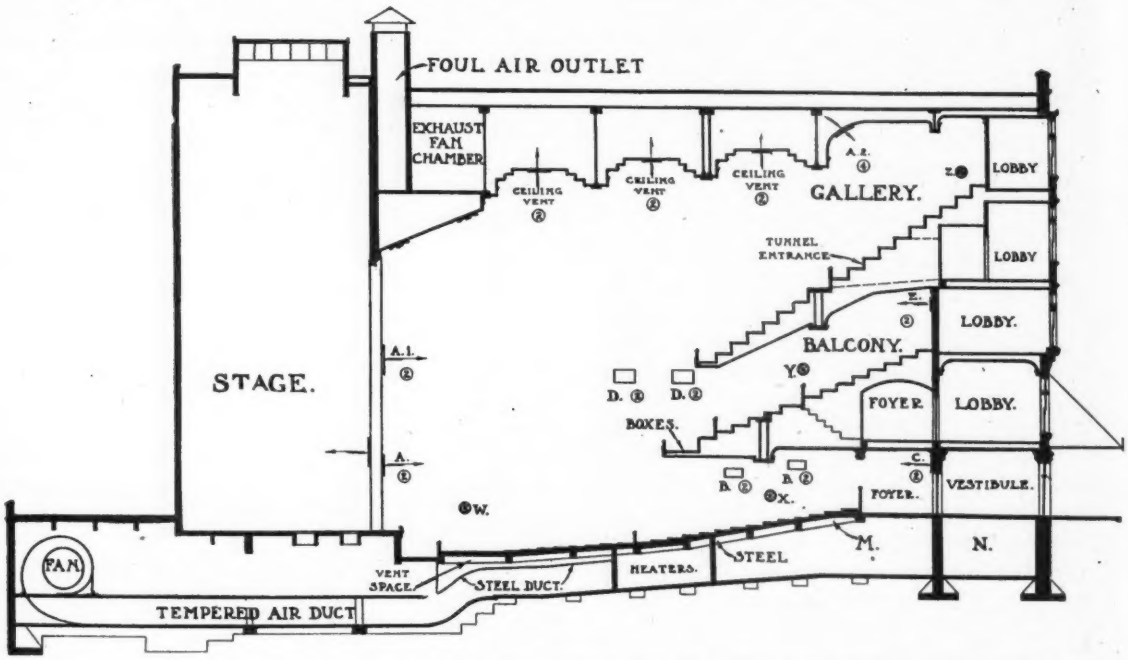


FIG. I—LONGITUDINAL SECTION OF THEATRE BUILDING, ON CENTER LINE, SHOWING ARRANGEMENT OF AIR DUCTS AND OUTLETS.

HEATING

The lobbies had entrances and stairways for the first floor and balcony separate from those for the gallery. They were supposed to be heated by direct radiation. The foyer had no provision for any heat at all, although there was considerable exposed wall surface. The auditorium was provided with adequate tempering, retempering and heating radiation, the latter being in six units adjacent to the plenum chambers. The heaters were encased in steel without any insulation and were hand-controlled by valves on the steam and return connections.

CONDITION AT TIME OF INSPECTION.

Some time after the plant was completed the following changes were made:

The basement ducts leading to flues E were cut off from these flues and connected so as to deliver fresh air into the former foul air chamber M, between the rear-most circumferential beam and the rear wall of the first floor. This chamber was closed off from its former connection with the foul-air collecting ducts at the side walls. The flues, E, however, were connected with these foul-air ducts. Thus, the seats in the rear panel across the house on the first floor were supplied with air by

upward action through the floor openings, and the air at the rear of the balcony was exhausted at the ceiling line.

Since the exhaust fan was directly over the proscenium arch, very objectionable noise and vibration was observed throughout the building when it was operated at anywhere near its proper speed. When running the supply fan without operating the exhaust fan, it is obvious that the very long and crooked foul-air and fresh-air ducts would cause so much resistance as to result in the delivery of a woefully deficient volume. Since the fans were depended upon for both supply and exhaust, their speed must necessarily be kept in proper relation with each other. Thus it was discovered that the slow speed on the exhaust fan, and full speed on the supply fan, caused very complex and irritating drafts in many parts of the auditorium. The custom, based on experience, was to operate both fans at less than one-half speed, resulting in a volume of air being put through so reduced in quantity as to be incapable of carrying off the surplus heat from the occupants.

TEMPERATURE REGULATION.

The temperature of the tempered air used for cooling was regulated by bypass dampers under the tempering and retempering heaters controlled by duct thermostats, arranged as follows:

W—Two thermostats, one on each side near the stage, controlled the air going to flues A, most of which, it will be noted, was delivered through the openings A-2.

X—Two thermostats, one on each side at the rear of the first floor, controlled the air going through flues B and C (six dampers).

Y—Two thermostats, one on each side in the balcony, controlled the temperature of the air going to flues D. They also controlled the dampers in ducts E, which, however, owing to the change mentioned before whereby risers E became vent flues. no longer discharged into the balcony but to the floor inlets under the seats at the first floor rear (space M).

There were no thermostats in the gallery, but this highest and probably warmest part received air influenced by the thermostats W in the lowest and probably coolest part of the room down on the first floor.

It should also be noticed that the thermostats Y in the balcony, a cooler place, were controlling the air delivered to the first floor rear, a warmer place, where different requirements would be expected.

TESTS.

Early in December, some preliminary observations were made while the plant was operating in the customary manner by the regular force of employees. It had been so operated for three and a half hours prior to the observations. The following temperatures were observed:

LOCATION	TEMPERATURES, DEGREES F.
Outside	41
Main lobby	63
First foyer	59
X—first floor	69
W—first floor	64
Y—balcony	66
Rear wall at center of balcony	69
Z—gallery	66

NOTES.—As a rule it was found that the north side was 1° cooler than the south side. The temperatures mentioned are those on the north, as the inlets, thermometers and building are symmetrical.

Openings A had been closed to reduce drafts.

Openings B toward the rear (2 of them) one on each side, had been closed.

Openings E were supposed to be vents, but showed no air movement.

Openings A-2 in the gallery were being operated as outlets.

The exhaust fan was running 126 r.p.m.; the supply fan was running at 78 r.p.m.

It is evident that insufficient area was provided for fresh air inlets, and that the system must have been more an upward than a downward one.

Very objectionable drafts were felt as follows:

First Floor: Coming down all aisles from the doors into the foyer. Caused by cold air from the same falling down the stairs from the balcony and spilling out into the first floor. Note foyer temperature but 59° after 3½

hours operation at 41° outside. Perceptible down draft from rearward all around front part of orchestra.

Balcony: Draft out into foyer from center entrance evidently to supply the air spilled out on first floor; cold draft in from upper entrances, following down aisles; (the upper balcony entrances are to a cul-de-sac and cannot circulate in the manner characteristic of those elsewhere). Cold draft from rear and northward across the boxes, which follow the curve at the lowest point of the balcony; noticeable upward current across face of balcony edge from below; strong drafts from inlets D and from A-1 observed within their range.

Gallery: Strong cold draft in through center entrances from cold lobby (59°), strong draft out through rear and highest entrances to cold lobby; strong drafts from A-1.

An analysis of these drafts indicates:

1. A strong current *out* at upper communications with the foyers, and *in* at lower communications with the same.
2. Poor diffusion of air, especially from A, A-1 and A-2.
3. Insufficient heating of the lobbies and foyer.
4. Insufficient air supply to give good ventilation.
5. Insufficient exhaust to remove surplus heat.
6. Undue loss of heat into the basement from the ducts, which run through the same. (The air to support the draft of the boilers was found to be obtained to a considerable extent by pulling heated air from the auditorium basement through a communicating passage.)

Inlets A were opened and by experiment found to be unavailable. Inlets B at first closed, were also found impracticable, because of drafts.

There was a very objectionable draft from above the switchboard on the stage, although the air inlet there was found to be closed. The chilling effect on the supply flues which ran a considerable distance along a cold outside wall was noticed.

CHANGES.

An analysis of the foregoing conditions made it evident that a radical revision in the entire system was necessary. Accordingly it was decided to make quick adjustments which would bring about the following changes, as follows:

a. Abandon the exhaust fan, using upward ventilation, induced by the pressure of the supply fan (since the exhaust fan noise and vibration could not easily be overcome).

b. Use the basement as an air supply chamber, thus heating the same so as to be sure of a warm first floor.

c. Abandon inlets B, C and E. Accordingly a number of openings, each about 2 ft. square, well distributed, were cut through the foul air chamber metal bottoms, giving access for fresh air to the entire foul air chamber system, and providing for excellent distribution of the air volume.

d. Ducts leading to flues B and C were torn down, so that they opened into the basement, and the old risers were closed tight. The manhole doors into the plenum chambers were opened, to give additional air supply to the basement. A tight partition was placed in the opening which formerly communicated with the boiler room. The two large vent stacks leading from the basement to the attic were closed tight. The former gravity vent ducts to the foul air outlet in the attic were removed, so as to give a greater free area of outlet. The openings A-2 in the gallery were arranged to deliver tempered air (since no thermostats in the gallery were provided). The six ceiling openings were arranged to vent freely through the attic space to the new enlarged foul air outlets. Deflectors were placed on inlets A-1. Inlets A were closed.

TEST WITH AUDITORIUM OCCUPIED.

On the night of December 10, the auditorium was occupied for a performance. The first floor was 90% full, the balcony was 50% full, and the gallery was unoccupied. The supply fan was run full speed—130 r.p.m. The tempered air temperature was 68° F. at 8 p. m., but by 9 p. m. had been reduced gradually to 66°. The tempera-

ture throughout the house, except lobbies and foyer, did not at any time vary more than one degree from 70°. Repeated inquiries of persons in various parts of the house failed to bring to light any complaints of either temperature or drafts. The lobbies and foyer were cold. There was a draft from the rear down the aisles from the causes described above.

On the morning of December 11, a test was made, operating exactly as last described, without any changes of any kind. About 1,000 candles were distributed, one on every other seat, in order to study draft conditions simulating occupancy of all the seats, and in order to observe temperature effects. These candles were of the standard plumber's type, such as has been taken by the Chicago Commission on Ventilation as giving off approximately twice as much heat as that from one person.

The plant was not operated to full supply fan speed until 10:45 a. m. The test started at 11:00 a. m., when all candles were lighted. The temperature outside was 34° F. and the tempered air was 66°. The results were as follows:

LOCATION	TEMPERATURES, F.				
	10:45	11:00	11:15	11:30	11:45
W	66	70	70	72	70
X	65	68	71	72	70
Y	66	68	70	71	71
Center rear of balcony	..	68	72	74	76
Center front of balcony	..	68	68	71	70
Sides of balcony at front	66	67	69	71	69
Foyer, first floor	60	66	..	..	..

The candles operated 45 minutes. The heat from them was very evident. Sufficient experimenting was done to demonstrate that it is possible with all the candles lighted (paramount to full occupancy), to reduce temperature at will in any part of the house, except in the pocket at the rear of the balcony. Since no changes, in the limited time available, had been possible in the automatic temperature regulation and the same was badly involved as before described, the controlling was done by hand, to a great extent. Twelve observers were distributed around the house, watching the candle flames for drafts and observing the thermometers. No. objectionable drafts were observed anywhere except the ever-present ones down the aisles, due to the cold foyer and lobbies, as before noted.

Special attention was paid to the center balcony boxes, from which many complaints had originated. The candles burned very steadily there and no drafts or unpleasant temperatures could be found.

Some deflection was noticed in range of the temporary crude diffusers on outlets A-1. Some draft, which is inherent, due to the large cold loft over the stage and which is present in all theatres, could be seen affecting the candles at the front of the orchestra. Since this comes from the front and is gentle, and since face currents are usually pleasant, no complaint from that source was apprehended.

The velocity through the floor inlets when running the fan at full speed was in no case found to exceed 130 lin. ft. per min. and averaged not over 110 ft. per min. Some adjustment of the volume dampers was required to bring this about. There was a marked improvement in conditions behind the proscenium arch. The draft over the switchboard had disappeared. The temperatures were excellent except in the pocket at the rear of the balcony. There was no outlet from this pocket and the temperature necessarily would rise under these conditions.

PERMANENT CHANGES.

Ventilation: To ventilate the upper part of the balcony, a number of openings were cut through the ceiling near E into the fireproof space under the gallery. A 42 in. propeller fan was connected with a duct leading from this space. This settled the matter of the overheating of the balcony.

Vertical blade diffusers about 6 in. wide, 3 in. on centers, were placed on the inlets A-1 to divert the air out toward the center of the gallery. These, with an adjustment of the existing horizontal diffusers, greatly improved conditions there.

The same type of diffusers was installed on the inlets D. The exhaust

fan and all of the attic ducts, except those leading from the flues A and inlets A-2, were removed.

Evenly-spaced openings were cut through the steel bottoms of all of the circumferential chambers under the first floor. These openings were provided with dampers so that the volume of air delivered could be easily adjusted.

All of the unnecessary metal ducts were removed from the basement, including the foul-air collecting ducts along the side walls.

A separate fan, heaters and ducts were provided for the main front vestibule, the fan being placed in the room marked N and arranged to recirculate the air. Thus a balanced pressure is maintained in the vestibule and there is no further difficulty due to drafts from this source, and it has been found possible to heat the room properly even when outside weather conditions were very severe.

Heating: Sufficient direct radiation was placed in the lobbies and foyers properly to heat the same. In the formerly very cold stair cases leading to the gallery a connection was made from the plenum chamber in the basement to registers behind the radiators so that these former direct radiators became indirects, and the heat given off by them was increased threefold.

Temperature Regulation: Two new thermostats were installed at Z in the gallery controlling the temperature of the air handled by the flues A, and delivered through the openings A-1 and A-2.

The thermostats Y were connected so as to control the temperature of the air handled by the flues D.

The thermostats X were changed so as to control the temperature of the air delivered into the rear part of the basement plenum chamber.

The thermostats W were changed so as to control the temperature of the air delivered into the front part of the basement plenum chamber.

Two additional thermostats were placed at W controlling progressively the steam supply to the re-heaters in the basement plenum chamber so as to preclude the possibility of overheating the air supply.

Since these changes have been made further tests have demonstrated that the heating and ventilating of this building is as satisfactory as any reasonable person could demand. The cost of heating the building has been very greatly reduced. In fact, quite satisfactory heating of the room is obtained without operating any fan at all, due to the peculiar construction which encourages gravity circulation.

Mechanical Requirements of a Modern High School Building

Schenley High School, Pittsburgh, Pa.

A month short of two years in building, the new Schenley High School, Grant Boulevard, Pittsburgh, Pa., recently opened, represents an investment of about $1,500,000. While no expense has been spared to build the best possible structure, everything else has been sacrificed in order to obtain simplicity with greatest utility. In addition to being used for school purposes during the daytime, the building is designed to serve the community in general. The building will be open for free use by the people for various community activities.

The building rests on 1,700 concrete piles, many of which are sunk 40 ft. into the ground. It is of steel and concrete construction, fireproof throughout, and faced on the exterior with Indiana limestone. Inside, it is finished in tile and oak. There are 180 rooms in the structure, including 40 classrooms, 11 laboratories, 11 shops, 4 crafts rooms, 7 domestic science rooms, 2 music rooms,

a library, an auditorium, and 6 commercial and accessory rooms. In addition there is a swimming pool with 32 shower baths, separate gymnasiums for boys and girls, a suite of offices, with master clock controlling the time in 27 clocks in the building, a medical department with complete equipment, a special room for girls presided over by a school mother, a bakery, two lunch rooms, and a laundry.

The high school proper occupies three floors; the shops, gymnasiums, swimming pool and lockers occupy the basement, while the sub-basements are given over to the electrical and mechanical plant and storage space. One wing of the building is fitted up as a complete

The general science and physics departments are provided with quarters and equipment representative of the latest practice. The science laboratory equipment is such as even very few of the universities of the country can boast. The lecture room of the chemistry department is fitted with every convenience to make complete demonstrations of experiments. Besides the lecture room, this department also has a general library, a preparing room, and other special rooms. It is also contemplated to put in force a preparatory electrical engineering course, and for this purpose a number of Westinghouse standard laboratory testing meters have been purchased.

SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.

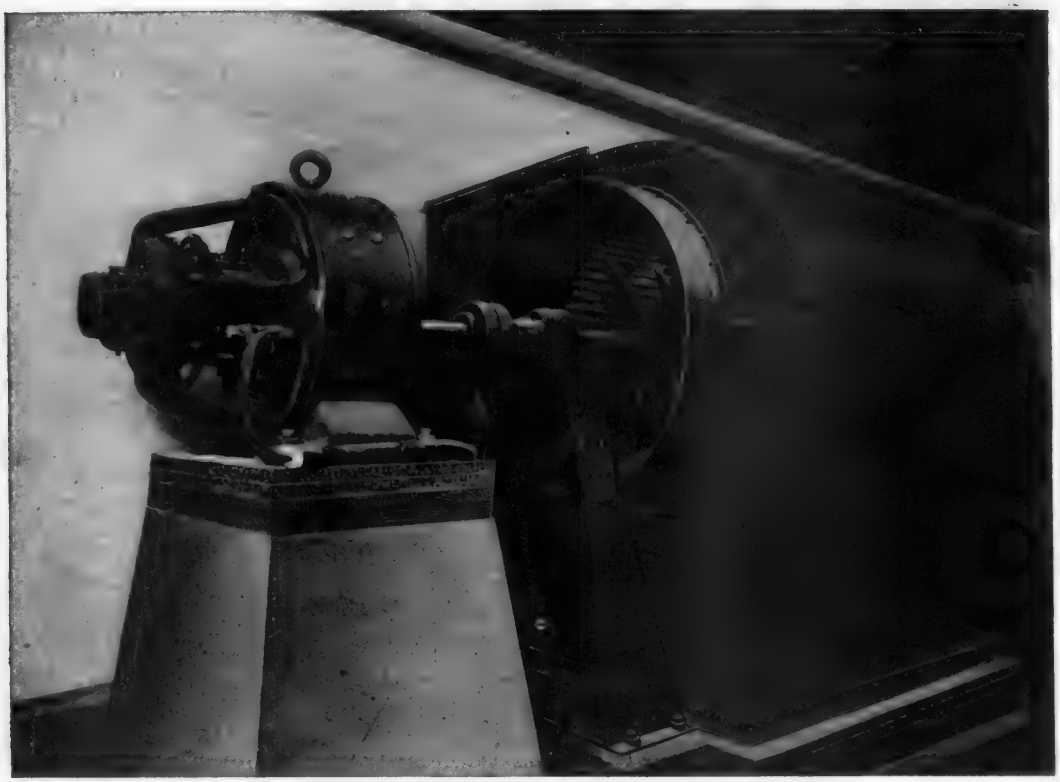
observatory. The auditorium is directly opposite the entrance, with entrances to balconies on the second and third floors. The stage is equipped with curtains and disappearing footlights. The auditorium is brilliantly lighted, as are the other parts of the building, for which purpose a total of over 2,136 watts in Westinghouse Mazda lamps are employed.

TABLET ARM CHAIRS USED IN PLACE OF DESKS.

In equipping the classrooms a radical departure has been made; the old-fashioned desk has been abolished and in its place a tablet arm chair is used, designed so that the pupil must sit in the correct hygienic position.

The library, it is expected, will be maintained as a branch of the Carnegie library. The shops include a manual training department with a full complement of motor-driven planers, lathes, etc., a molding department and a complete printing plant, employing individual motor drive.

The lunch rooms will feed 1,800 students, boys and girls separately, in 30 minutes, on the caféteria plan. The kitchen is the most completely equipped of any of the school kitchens in the United States, and has many electrically-driven appliances, such as dishwashers, potato peelers, and food choppers. The cooking can be done by gas or steam, or by means of two 12-gallon fireless cookers. The bakery, where 100 dozen rolls



TYPICAL SUPPLY FAN AND SETTING FOR THE SCHENLEY HIGH SCHOOL.

will be made daily, has a one-barrel-capacity dough-mixer, operated by an electric motor. The same motor also operates a cake mixer.

ELECTRICAL APPARATUS.

As in every other detail, the heating and ventilating equipment installed is representative of the best practice. The boilers are served by four stokers furnished with forced draft by a No. 6 Sirocco blower, operated by a commutating-pole, direct-current Westinghouse motor. For ventilating purposes air washers, supply fans, and exhausters are employed. There are nine B. F. Sturtevant supply fans and ten exhausters made by the same company, each of which is driven by a direct-current Westinghouse motor. There are also eight air washers, made by the Carrier Air Conditioning Company, each of which is driven by a 2½ h.p. direct-current Westinghouse motor. The air is drawn from outdoors, purified and moistened by the air washers, brought up to the proper temperature, and sent through the main

ONE OF THE EXHAUST FANS AND SETTING FOR THE SCHENLEY HIGH SCHOOL.

supply fans. The foul air and odors from the kitchens are exhausted by fans located near the roof. A fresh supply of air is possible three times in ten minutes. The temperature is controlled from a two-panel Westinghouse switchboard which operates a thermostatic heat control system.

Forced draft for the forges in the machine shops is furnished by a B. F. Sturtevant Monogram blower, driven by a 10 h.p. direct-current Westinghouse motor.

All motors, blowers and exhausters are mounted on bases composed of 4 in. of wood, 4 in. of cork, and varying degrees of concrete. The motors are direct-connected to the driven apparatus by flexible couplings.

Three-phase, 60-cycle, 2,200 volt alternating current is furnished from the lines of the Duquesne Light Company, and is delivered by a transformer substation maintained by the light company, on the premises, where the voltage is stepped down. Inasmuch as all motors and lights are operated on direct-current at 230 volts, two 300-kw, 6-phase rotary converters, manufactured by the Westinghouse Electric & Mfg. Company, have been installed. These change the alternating-current to direct-current of proper operating voltage. The main switchboard, also furnished by the Westinghouse company, contains two panels, two for the rotary-converter circuits, two for motors, and two for lighting.

Manufactured Gas for House Heating

With Relative Costs of Heat Energy as Supplied by Various Fuels and District Heating Systems.

By GEORGE S. BARROWS and C. C. WINTERSTEIN.

(From a paper read before the American Gas Institute.)

Current periodicals and literature on the subject of house heating indicate but little careful study of the use of manufactured gas for house heating and it appears as if it is categorically assumed that it is out of the question. For this trend of opinion we may be to blame for insufficient publicity as is indicated by a recent edition of a handbook on heating and ventilation, published by a well known engineer, in which the author has found it pertinent to add a short chapter on electrical heating and has made therein an approximate computation of the relative costs of electrical and coal heating. No similar comment, however, is to be found regarding the relative costs of gas and coal heating and the thought naturally arises, therefore, as to what the motive could have been which impelled this authority to span the breach between these two widely different methods of house heating while entirely ignoring the fuel, gas. It would seem that the electrical industry, despite obvious obstacles, has been able to demand a hearing in the consideration of this topic while the more logical fuel, gas, and we refer here to manufactured gas in particular, has failed to make a very deep impression.

FACTORS GOVERNING SELECTION OF FUEL.

Summarizing the factors entering into the selection of fuel, using as the base for comparison manufactured gas in those cases where the uses of the fuels are fairly comparable and neglecting fuel cost, we have:

	Anthracite Coal	Bituminous Coal	Coke	Oil	District Heating	Electricity
COST						
Investment	Same	Same	Same	Worse	Better	Worse
Maintenance	Worse	Worse	Worse	Worse	Better	Same
Thermal Efficiency	Worse	Worse	Worse	Same	Better-a	Better-a
Labor	Worse	Worse	Worse	Worse	Better	Better
Insurance	Same	Same	Same	Worse-b	Better-b	Better-b
CONVENIENCE						
Reliability	Worse	Worse	Worse	Worse	Worse	Worse
Ease of handling	Worse	Worse	Worse	Worse	Better	Better
Control	Worse	Worse	Worse	Same	Same	Same
Character of heat	Same-c	Same-c	Same-c	Same-c	Same-c	Same-c
CLEANLINESS						
Fuel before use	Worse	Worse	Worse	Worse	Same	Same
Fuel residue	Worse	Worse	Worse	Same	Better	Better
Control of air	Same-d	Same-d	Same-d	Same-d	Same-d	Same-d

(a)—Except with certain gas appliances.
(b)—In certain cases specified by fire insurance underwriters.
(c and d)—Only in cases where the appliances are such as to make the fuels directly comparable.

from which we see that gas is more desirable than any other heating medium (fuel) except district heating and electricity. (Consideration of fuel costs follows further on.)

"CENTRAL" HEATING.

There are three distinct methods in use to-day for heating buildings from a central heating plant located on the premises, namely:

1. Hot air.
2. Hot-water.
3. Steam.

These methods are at present applicable to any fuel except electricity. Their general principles are so well embedded in the minds of us all that it is unnecessary to relate them here. Our object is to endeavor to show the possibilities of these various systems when operating them with manufactured gas and to draw a comparison of systems so operated using coal as an example. The fundamental working basis in making this comparison is the amount of work to be done and this work is the same whether we are using one fuel or another. It represents the amount of radiation which must be taken care of. Manifestly, this amount of heat is dependent on the construction of the building, the maximum differential temperature between the inside and the outside temperatures, and the required air renewals. It will not differ according to the fuel selected.

Having determined the total amount of heat necessary, one of the first points to present itself for consideration is the efficiency of the heating unit, that is, the percentage of the total heat in the fuel which the heating unit is capable of delivering for utilization. Assuming that the heat lost by radiation from the heating unit and its house connection is usefully employed, the unavailable heat in the coal operated apparatus will be represented by the stack losses (including loss due to incomplete combustion of carbon) and the unburned fuel loss, and in the case of the gas operated apparatus by the stack losses only (no incomplete combustion). The amount of unburned coal dropping through with the ash will depend upon the care of the operator and the efficiency of the grate. In a well designed heater operated with reasonable care this loss will average from 5 to 10%.

DISTINCTION BETWEEN PURPOSES OF STACK.

Regarding the stack or flue loss it will be well to call attention first to the distinction between the purposes of the two stacks when operating with the two fuels. In the case of coal the fundamental object of the stack is to create a

sufficient draft (negative pressure as compared to atmospheric pressure) to draw in the necessary air for combustion. In the case of gas the fundamental object of the stack is to carry off the products of combustion to the outside atmosphere and thereby prevent vitiation of the inside atmosphere. In each case the draft must be great enough to overcome the resistances of the various passes and flues to the flow of the products.

The resistance offered to the flow of the products by the spaces between the burners is extremely small compared to the resistance offered by a solid fuel bed and hence the requisite draft for the operation of the gas heater is much lower than that for the coal heater because of this factor alone. In a coal heater probably 30% to 40% of the circulating pressure or potential draft is utilized in overcoming the resistance of the fuel bed.

The remaining factors are all dependent on the velocity of flow. In the gas heater this velocity is less than in the coal heater, since the volume of the products is less, and the resistance losses therefore will be proportionally smaller. This, of course, is based on the assumption that both coal and gas heaters are constructively alike.

Regarding the stack loss, the resistance to flow and consequently the draft necessary to overcome it, would be greater in the case of the gas heater due to decreased stack diameter and higher flue gas density, but these factors are offset by the reduced velocity as already noted. In the accompanying table (Table I) are given two theoretical determinations for coal and gas heaters based on certain assumptions. The starting point in these determinations is the requirement that 200,000 B.T.U. (about 800 sq. ft. steam radiation or 1,330 sq. ft. hot water radiation) are to be supplied hourly. Anthracite coal having a calorific value of 13,770 B.T.U. per pound is selected for the coal installation and carbureted water gas having a calorific value of 600 B.T.U. per cubic foot is selected for the gas installation. The thermal efficiency of the coal heater is taken as 55% and that of the gas heater as 75%. An excess of 160% air is assumed for the combustion of the coal and only 50% for the combustion of the gas. The same radiation loss, 12%, is taken in each case and an unburned fuel loss of 3% is assumed for the coal heater. By difference the flue losses amount to 30% and 13% for the coal and gas heaters respectively. A further assumption in the case of the coal heater is the presence of 0.5% carbon monoxide in the flue gases. This amounts to an hourly loss of 15,400 B.T.U. or 4.2% of the total heating value of the fuel.

The calculated flue temperature amounts to 550° F. in the coal installation and 296° F. in the gas installation, these temperatures producing circulating stack pressures (potential drafts) of 0.31 and 0.215 in. of water respectively. With assumed stack heights of 40 ft., the diameter of the stack for the coal heater is calculated to be 12 in. and that for the gas heater is calculated to be 7 in.

TABLE I—THEORETICAL DETERMINATIONS OF COAL AND GAS CENTRAL HOUSE HEATERS.

Coal		Gas	
Kind:		Kind:	
Anthracite.		Carbureted water gas.	
Ultimate Analysis:		Composition:	
Carbon	85.94	Illuminants	10.7
Hydrogen	2.41	33.6% benzene—3.6	
Nitrogen	0.88	66.4% ethylene—7.1	
Oxygen	2.17	Carbon monoxide	33.4
Ash	8.08	Hydrogen	38.1
Volatile Sulphur	0.52	Methane	7.6
	100.00	Ethane	2.4
Proximate Analysis:		Carbon dioxide	3.3
Moisture	2.25	Oxygen	0.7
Volatile matter	8.06	Nitrogen	3.8
Fixed carbon	81.80		100.00
Ash	7.89		
	100.00		

	Coal	Gas
Calorific value dry coal, B.T.U.	13,770	
Calorific value (gross) of gas, calculated, B.T.U.		600.3
Assumed volume of air required per pound coal, cubic feet	350	
Theoretical volume of air necessary for complete combustion, cubic feet	134	5.12
Per cent excess	160	50 (assumed)
Calculated volume of air per cubic foot of gas, cubic feet		7.68
Assumed relative humidity of gas, per cent		50
Assumed outside temperature of air, deg. F.	32	32
Assumed relative humidity of outside air, per cent	80	80
Assumed temperature of inside air, deg. F.		50
Assumed relative humidity of inside air, per cent	50	50
Assumed thermal efficiency of coal heater, per cent	55	
Assumed thermal efficiency of gas heater, per cent		75
Assumed radiation loss, per cent	12	12
Assumed flue loss, per cent	30	13
Assumed unburned coal loss, per cent	3	
	100	100
Assumed total hourly heat required, B.T.U.	200,000	200,000
Calculated hourly heat in fuel, B.T.U.	363,636	266,667
Pounds of coal per hour	27.02	
Cubic feet of gas per hour		444.3
Heat lost by radiation per hour, B.T.U.	43,636	32,000
Heat lost in flue per hour, B.T.U.	109,091	34,667
Heat lost in unburned coal, B.T.U.	10,909	
Assumed percentage of CO in flue gases	0.5	
Calculated carbon dioxide, per cent	7.05	11.3
Calculated oxygen, per cent	13.39	7.2
Calculated nitrogen, per cent	79.06	81.5
	100.00	100.00
Hourly heat loss due to presence of CO, B.T.U.	15,399	
Pounds of water formed by combustion of fuel, per hour	5.739	17.912
Pounds of water in combustible as fired per hour	0.608	0.139
Pounds of water in air supplied per hour	2.979	1.064
Total pounds of water in flue products per hour	9.326	19.12
Calculated temperature of flue products, deg. F.	550	296
Hourly volume of products at flue temperature, cubic feet	18,930	5,390
Weight of 1 cubic foot air at 32° F.—0.8 R.H.	0.0803	0.0803
Weight of 1 cubic foot products:		
at 550° F., pounds	0.04	
at 296° F., pounds		0.0524
Circulating stack pressure, number of square feet per foot, pounds	0.0403	0.0279
Assumed stack height, feet	40	40
Circulating stack pressure, inches of water	0.31	0.215
Calculated stack dimensions:		
if square, inches	11x11	7x7
if round, inches diameter	12	7
Dewpoint of products, deg. F.	64	118

The hourly volumes of the flue products, figuring them at the determined flue temperatures, are calculated to be 18,900 cu. ft. and 5,390 cu. ft. respectively, and the total hourly weight of moisture carried off by the products 9 lbs. and 19 lbs. respectively. This moisture weight includes that present in the air and also that present in the unburned gas.

The hourly coal charge amounts to 27 lbs. and the hourly gas consumption to 444 cu. ft. Figuring coal at $7.00 per ton and gas at $1.00 per thousand, the cost with coal is here 8.4c per hour and that with gas 44.4c. This is a ratio of 1 to 5.3. With gas at 80c and 60c per thousand the ratios are 1 to 4.2 and 1 to 3.2 respectively.

REDUCING TEMPERATURE OF FLUE PRODUCTS.

Without considering yet any change in the assumed thermal efficiency of the coal heater, which efficiency represents that obtainable when operating the coal heater under the most favorable conditions, it will be well to see what saving could be effected in the gas installation by a reduction in the temperature of the flue products. We have already seen that a strong draft is not essential for the operation of the gas heater and as the draft is a function of the flue temperature, it will be perfectly safe to reduce this temperature to a relatively low point. Gas heater installations have been successfully operated with stack temperatures of 140°, this reduction having been obtained by the use of an economizer located in the uptake. If, in our problem, the flue temperature were reduced to 140° by the use of the accessory just noted, an hourly saving of 10,599 B.T.U. could be effected, which represents 3.96% of the total energy in the fuel. At 140° we are nearing the dewpoint of the products, which, it will be noted is 118°. If the water or gas entering the economizer is less than 118° some of the moisture may be condensed, the amount so condensed depending on the incoming temperature. Supposing that 50% of the water vapor could be condensed at 140°, then about 9,060 B.T.U. would be transferred to the economizer, the greater part of this heat resulting from the recovery of the internal energy of evaporation. This would represent a saving of about 3.4%.

An economizer could be usefully employed for preheating the return water in a hot water system or preheating the air in a hot air system. It would hardly be warranted in the steam system owing to the relatively high temperature of the returned condensation. It might be economically employed in any of the three systems for heating hot water for general household purposes.

In passing, it may be noted that at 140° and with 50% of the moisture condensed the potential draft would be 0.1 in. of water. The overall thermal efficiency of the installation would become equal to about 82%.

If now, the radiation loss, by the use of good lagging can be reduced to 6%, and the flue loss be maintained at 6% by the use of an economizer, as just noted, the saving effected by the economizer would increase to about 13% and the overall thermal efficiency to 88%.

The 55% thermal efficiency assumed for the coal heater, it must be remembered, is high, and as stated above represents the efficiency obtainable when operating the heater under the most favorable conditions. The average efficiency would be more nearly 40% and as low as 25% when operating the heater at low capacity. With a 40% efficiency the hourly fuel cost of the coal heater in our problem would increase from 8.4c to 11.6c, which, compared to the hourly fuel cost of the gas heater at 85% efficiency, would give the following ratios:

Gas at $1.00	1 to 3.4
Gas at .80	1 to 2.7
Gas at .60	1 to 2.0

With the coal heater operating at one-half the load called for in the problem and at an efficiency of 25%, and the gas heater likewise operating at this load but with an efficiency of 75%, the fuel cost ratios would be as follows:

Gas at $1.00	1 to 2.4
Gas at .80	1 to 1.9
Gas at .60	1 to 1.4
Gas at .50	1 to 1.2

At ¼ load, with the same efficiency for the coal heater, namely, 25%, and a 65% efficiency for the gas heater, our ratios would become:

Gas at $1.00	1 to 2.8
Gas at .80	1 to 2.2
Gas at .60	1 to 1.7
Gas at .50	1 to 1.4

(In concluding their paper, the authors brought out the fact that the National Commercial Gas Association, through its committee on heating, has suggested some experimental types of auxiliary gas house heaters and the authors recommended that these or similar installations be followed up, more tests made with appliances modified as

TABLE II.—RELATIVE COSTS OF HEAT ENERGY AS SUPPLIED BY VARIOUS FUELS AND DISTRICT HEATING SYSTEMS.

Fuel or Heating System.	Calorific Value, B.T.U.	Fuel Cost.	Thermal Efficiency, Per Cent.	Cost of 1,000,000 Useful B.T.U., Cents.
Gas mixed, coal and water.	600 per cubic foot	Per M cubic feet.		
		$1.00	100	167
		.80	100	133
		.60	100	100
		.50	100	83
		1.00	80	208
		.80	80	167
		.60	80	125
		.50	80	104
		1.00	60	277
		.80	60	222
		.60	60	167
		.50	60	139

In the term "Gas equals 100," the figure 100 is an abstract value selected as a convient base to which the tabulated figures can be compared. Thus, the first tabulated figure "13" indicates that with anthracite coal of 14,000 B.T.U., selling at $7.00 per ton, and burned in a furnace of 100 per cent. thermal efficiency, and with gas of 600 B.T.U., selling at $1.00 per 1,000 cubic feet, and also burned in a furnace of 100 per cent. thermal efficiency, the relative fuel cost of coal to gas will be as 13 is to 100. Again, the last tabulated figure, "421," shows that with electricity selling at 2 cents per K.W.H., and generated in an electrical heater of 1,000 thermal efficiency, and with gas of 600 B.T.U. selling at 50 cents per 1,000 cubic feet, and consumed in a furnace having an efficiency of 60 per cent., the relative cost of electricity to gas will be as 421 is to 100.

Relative Cost Gas Equals 100

					Thermal Efficiency 100 Per Cent.				80 Per Cent. Cost Per M.				60 Per Cent			
					$1.00	.80	.60	.50	$1.00	.80	.60	.50	$1.00	.80	.60	.50
Anthracite coal	14,000 per lb.	$7.00 per ton	100	22.3	13	17	22	27	11	13	18	21	8	10	13	16
			60	37.2	22	28	37	45	18	22	30	36	13	17	22	27
			40	55.7	33	42	56	67	27	33	45	54	20	25	33	40
			25	89.3	53	67	89	107	45	53	71	86	32	40	53	64
Bituminous	14,000 per lb.	$4.50 per ton	100	14.3	8.5	11	14	17	7	8.5	11.5	14	5	6.5	8.5	10
			60	23.8	14	18	24	29	11.5	14	19	23	8.5	11	14	17
			40	35.8	21	27	36	43	17	21	29	34	13	16	21	26
			25	57.4	34	43	57	69	28	34	46	55	21	26	34	41
Coke	14,000 per lb.	$7.50 per ton	100	23.8	14	18	24	29	11.5	14	19	23	8.5	11	14	17
			60	39.8	24	30	40	48	19	24	32	38	14	18	24	29
			40	59.7	36	45	60	72	29	36	48	57	22	27	36	43
			25	95.6	57	72	96	112	46	57	76	92	35	43	57	69
Fuel Oil	17,800 per lb. 117,500 per gallon	$0.06 per gallon	100	51	30.5	38	51	61.5	24.5	30.5	41	49	18.5	23	30.5	37
			80	64	38	48	64	77	31	38	51	61.5	23	29	38	46
			60	85	51	64	85	102	41	51	68	82	31	38	51	61
District Heating—Steam and Hot-Water		20,000 B.t.u. $0.01		50	30	38	50	60	24	30	40	48	18	23	30	36
Electricity	1 Kw. hr. 3,412 B.T.U.	$0.10 per Kw.hr.	100	2930	1750	2200	2930	3530	1405	1750	2340	2820	1060	1320	1750	2100
		0.08	100	2340	1400	1760	2340	2820	1120	1400	1870	2250	845	1050	1400	1680
		0.06	100	1760	1050	1320	1760	2120	847	1050	1410	1690	635	794	1050	1270
		0.04	100	1170	701	880	1170	1410	562	701	936	1120	423	527	701	842
		0.02	100	586	350	440	586	706	282	350	468	563	212	264	350	421

experience shows best, and that a committee on house heating design and installation be appointed by the Institute to co-ordinate the work of the members and co-operate with the similar committee of the National Commercial Gas Association for the furtherance of this work.)

Supplementary Report of Heating Engineers' Meeting

Summaries of Papers Mentioned by Title in Last Months' Issue.

Notes on Warm Air Furnace Heating.

By Jesse M. McHenry.

This paper dealt with the moderately-sized gravity furnace system for heating the average home. Mr. McHenry stated that technically-trained heating and ventilating engineers have heretofore withheld approval of this system but he stated that there was a growing interest in this system being shown by engineering colleges. Mr. McHenry endorsed the formula and rules for installation of warm air heating, issued by the National Warm Air Heating and Ventilating Association. He then presented the results of several furnace tests made to determine the efficiency and the causes of heat loss. Efficiencies were obtained running from 64% to 87%. The latter figure was obtained with a 25-in. diameter firepot, burning 5 lbs. of coal per hour. The tests demonstrated, said Mr. McHenry, the wisdom of using furnaces of generous proportions. Under forced circulation, the efficiency was 3% higher in one case, 2% in another and 5% in a third.

In the tests for radiation losses, the losses from the outer casing were found to be negligible, provided the cold air supply is adequate and a reasonably low rate of combustion is maintained. The chimney losses test showed that they may be reduced slightly by doubling the fire travel, with the requirement of only 0.01 in. (water) increased draft pressure.

Some notable results were obtained in tests on the use of extended surfaces to the fire pots. It was found that the frictional resistance due to the presence of the extensions restricted the air velocities, and lowered the efficiency, instead of increasing it. The extensions were set radially, and in the opinion of the author, are of very doubtful value.

Windows.

By Dr. E. Vernon Hill.

In this paper Dr. Hill reviewed the history of window design and construction and showed that windows were in use in ancient Egypt, at least on the second floors of buildings, but without glass or other protection. That they were also used by the Greeks and Romans is known to be a fact. Instead of glass it was customary to use pieces of colored glass. Dr. Hill then took up modern window construction from the standpoints of first cost, care and upkeep, loss of wall space, admission of flies and other insects, admission of dirt, weakening of walls and injury to building, entrance for burglars, increase of heat loss, interference with mechanical ventilation, increased liability to fire and fire panic and nuisance from noise. Under the last heading he showed that in office buildings in the congested districts of large cities, the noise from electric cars, passing trucks, etc., entirely prevent the use of windows for ventilation on the first, second or even third floors. This is also a serious objection in the cases of hospitals and schools. Dr. Hill spoke at length of the window requirements of factories and workshops, this part of the paper being accompanied by illustrations of typical designs. He stated that pending further development of artificial illumination, natural light for these buildings is to be preferred. He predicted that in the years to come all workrooms, salesrooms and rooms open to the public below the second story above grade would be compelled to be properly ventilated and the air washed and purified.

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IN RECENT years no single item has engaged more attention in heating circles than the advantages of humidified air in connection with the heating of interiors. These advantages have usually been presented from the hygienic standpoint, the argument being made that most of us live in overheated homes and that the supply of additional moisture to the air makes it possible to have equal comfort at a considerably lower temperature. Once in awhile, however, a rash spirit arises to point out the fuel economies to be obtained by this procedure on the ground that the maintenance of a lower indoor temperature, even with a high humidity supply, is a fuel-saving proposition. Many of these enthusiasts point confidently to the coal pile and present carefully-compiled figures showing the savings obtained after humidifying devices were installed.

In connection with such a demonstration in this issue, we present an analysis of the heating and humidity data for a typical condition and the conclusions will, we are sure, coincide with those of most of our readers who have had occasion to take up the matter. They show, briefly, that where there is any considerable range of heating required the evaporation of the necessary amount of moisture to permit a lowering of the air temperature is certainly not a source of economy.

Here we have the cold facts of physics opposed to the confident claims of many whose experiences point in diametrically the opposite direction. How are these experiences to be reconciled with the general laws of physics? Does it mean that in cases where savings are effected, use is being made of a certain portion of the heat that is otherwise wasted? This, in the opinion of many, is the true explanation of the paradox. We should be glad to open our columns to a further discussion of this subject.

ANOTHER phase of the matter brought out in the discussion refers to the advantages of "humidified air" over warm, dry air, which are frankly questioned. Such an argument will appeal to most engineers as a distinctly backward swing of the pendulum, yet plausible points are presented to prove the contention. This in itself might not attract so much attention were it not for the fact that almost identically the same views were expressed by the engineer of a prominent camera concern, in a recent address before a well-known engineering society.

FOLLOWING the custom established some months ago of devoting at least one issue of THE HEATING AND VENTILATING MAGAZINE, during a quarter, to a special subject, we are planning to make the next (April) issue a Central Station Heating Number. The April number will review some of the more important developments in district heating, together with examples of important recent practice in this field

The Consulting Engineer

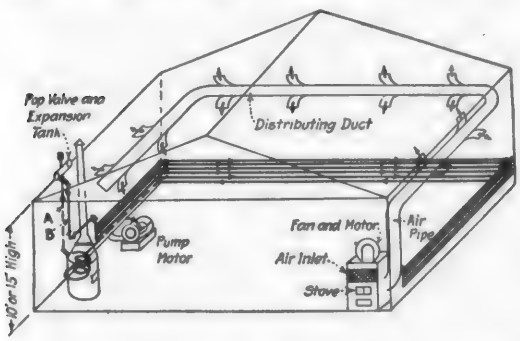
"The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

CONDUCTED BY IRA N. EVANS

72—Methods of Heating Portable Buildings.

QUESTION: Can you suggest a method of heating portable hospital units, such as are used in connection with military camps?

ANSWER: There are several methods that might be employed which are along the line of car-heating devices. One is the Baker hot water car heater, shown in Fig. 1. This has been used successfully for years in heating railroad coaches when they are left on sidings or on branch roads for long periods without connection to the locomotive. A notable example was in connection with the trains on the Brooklyn Bridge, when the cars were operated by cable. The boiler or heater is set on the same level as the coils and the supply pipe is carried through the roof, with a small expansion tank and pop safety valve set at 15 or 20 lbs. The supply pipe is taken from the expansion tank and these two pipes, A and B, give the difference in head



FIGS. 1 AND 3—BAKER HOT WATER CAR HEATING SYSTEM AND PETER SMITH CAR HEATING SYSTEM.

to circulate the water. The return is taken to the boiler which is nothing more than a coil of pipe in a stove.

Oil could be burned instead of coal, with burners similar to those used in the Detroit vapor stove. These burn either oil or kerosene. The firepot, when burning oil, should be filled with broken firebrick so that the high-temperature flame from the oil could be properly utilized. In the sketch a coil is shown, but if the weight were a considerable item in transportation, sheet metal radiators could be connected in series with a 2-in. pipe, in the same manner as shown for the pipe coil.

If current were available a small motor pump, of ⅓ or ½ H.P., could be connected in the circuit and used or not, as desired.

This apparatus circulates on rather high

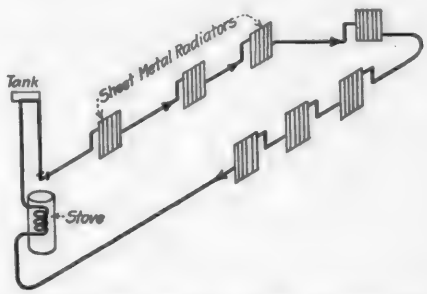


FIG. 2—ARRANGEMENT OF BAKER SYSTEM, WITH SHEET METAL RADIATORS.

temperature, up to 5 or 10 lbs. and a corresponding temperature of 227° to 250° F., so that the heating surface could be comparatively light in weight, especially if sheet-metal radiators were used.

Fig. 3 shows a scheme of heating used by the trolley cars in Detroit, made by the Peter Smith Heater Co., which is nothing more than a stove with a small motor and blower on top. The air is blown over the firepot and passed under the seats, recirculating the air of the car. As applied to the case in hand, firebrick could be placed in the firepot and gasolene or kerosene used with a Detroit vapor stove burner. The air-distributing pipes could be collapsible by making them of canvas or sheet metal, with the air distribution overhead.

Of course, this would require electrical current, but with the automobile engine available, a small portable plant could be rigged up to light the whole camp and take less bulk fuel than if torches or lamps were used. Such lighting plants are available in the trade.

The coils would probably be too bulky and weigh too much to transport. The Peter Smith, rig, however, should be very efficient and not of very great weight or bulk. Several of these rigs could be used, as desired.

"Fight for the Straight Red Line."

There is a new slogan in one of the bureaus of the Chicago City Hall. This new battle cry of health is, "Fight for the straight red line." Just what this means will be understood by those who heard Dr. E. Vernon Hill, head of the Chicago ventilation bureau, explain his synthetic air chart at the recent annual meeting of the heating engineers.

It sounds like a queer object of zealous combat, but as explained by Dr. Hill, it is simply a method of putting one's finger, so to speak, on the conflicting factors which make comfortable air conditions. The chart and its use are explained at length by Hermann B. Deutsch, in the Civil Service News.

Formerly if a room became stuffy some one opened a window and let it go at that. Then came the mechanical ventilating system and for a long time it was thought necessary only to supply 30 cu. ft. of fresh air per minute to each person.

The synthetic air chart makes it possible to accurately grade air conditions according to a percentage scale. In connection with its use a series of odor solutions is provided by means of which the relative strength of odors can be determined on some other basis than guesswork. Also a ventilation cabinet is used for testing the effect of various contaminations of air on human beings, and, finally, an instrument is included for counting the number of appreciable dust particles in a given quantity of air.

"Our recent investigations," says Dr. Hill, "have shown that there are a number of factors which determine whether or not the ventilation of a room is what it should be. These factors may be classed under three headings:

"First—Physical conditions, by which we mean the temperature, humidity and motion of the air.

"Second—Contamination conditions, by which we mean the amount of impurities in the way of dust, bacteria or bad odors which the air contains.

"Third—Quantitative conditions, by which we mean the amount of air supplied to each individual, which determines, to a large extent, the amount of oxygen, carbon dioxide, and bodily impurities carried in the air, and the distribution of the air."

USING THE CHART.

According to Dr. Hill, such complaints as "The air in this room is foul," or, "My, but this place is stuffy!" are meaningless. The air may be foul for any one of a number of reasons, and in a great many cases, merely increasing the air supply will not remedy the situation in the slightest.

That is how the synthetic air chart illustrated herewith was developed. In the first division, the three factors considered are (1) temperature, (2) relative humidity, and (3) air motion. These factors are absolutely dependent upon each other. A temperature which is all but intolerable on a moist day, when the humidity is high, is no more than comfortable on a dry day, when the humidity is low. A temperature which "wilts" people when the air is still, becomes pleasantly grateful when the air is in motion. To illustrate: On a hot, "sticky" day, when the air is very still—the sort of day usually described as "close," one is decidedly uncomforable. Yet if on the same day, one is riding in an open automobile, so that the wind of the machine's progress drives off the "closeness," the same conditions of temperature and humidity become almost ideal.

RELATING THE THREE FACTORS.

The problem confronting the army of the "Straight Red Line," then, was one of relating these three factors of temperature, humidity and air motion as closely on a chart, as they were related in actuality. This was accomplished as shown on the first division of the synthetic air chart, where we have horizontal lines, vertical lines and curves. The horizontal lines denote the degree of temperature, the vertical lines the degree of air movement, and the curved lines the degree of relative humidity.

This can be illustrated by choosing at random any temperature—72° F., let us say. A glance at the chart will show that the horizontal line which represents 72° is cut by the relative humidity curve of 40%. The 72°-line is crossed by the 40% curve at a vertical division corresponding to an air movement of about 30 ft. a minute. Translated into terms of ventilation, this means that at 72° F., with a relative humidity of 40%, the air should be moving 30 ft. a minute to insure comfort. Glancing further at the 72°-line, it is cut by the 50% humidity curve at an air velocity of a little over 100 ft. a minute; by the 60% curve at 300 ft. velocity per minute; by the 70% curve at an air velocity of 500 ft. a minute, and by 80% curve at an air velocity of 850 ft.

HOW THE RIGHT DEGREE IS FOUND.

Let us say, then, that a ventilation expert steps into a school room concerning

which a complaint has been made. He measures the relative humidity with a sling psychrometer, and finds that the relative humidity is just 50%. He measures the velocity of air movement by placing in front of the ventilation register a manometer and this dial registers 100 ft. per minute. He consults his chart and finds that the 100 ft. per min. line is cut by the 50% humidity curve at the horizontal temperature line of 71°. But the thermometer of the room registers 73°. And there you have one factor that may be causing the whole trouble. The room is exactly 2° too warm. This is indicated on the chart by making a red line two divisions above the base—there is a two-degree penalty for a two-degree improper condition.

How is it known that these conditions are comfortable? How can the ventilation experts tell that at a certain degree of temperature with a certain per cent of air movement the air should be moving just so fast and no faster? The answer is that it was determined by countless actual experiments. A factory room was donated to the use of the Chicago ventilation bureau for this purpose The room contained several steam jets, by which moisture could be sprayed into the air in any desired quantity or per cent. The room was equipped with special blower fans by means of which the amount and velocity of air motion could be controlled to a nicety. And finally the room was equipped with six large radiators, through which the temperature could be controlled exactly within a wide range.

CONTROL CONDITIONS FOR EXPERIMENTS.

A definite percentage of moisture was sprayed into the air. The radiators were set to a definite temperature. And the "victim" of the experiment was seated in the room and the air motion was gradually raised or decreased by the blowers until the point of greatest comfort was reached. The same experiment was performed with many people under all the different possible combinations of conditions. The air experts know that the points on the chart are the proper points of greatest comfort, because they have been actually tried on

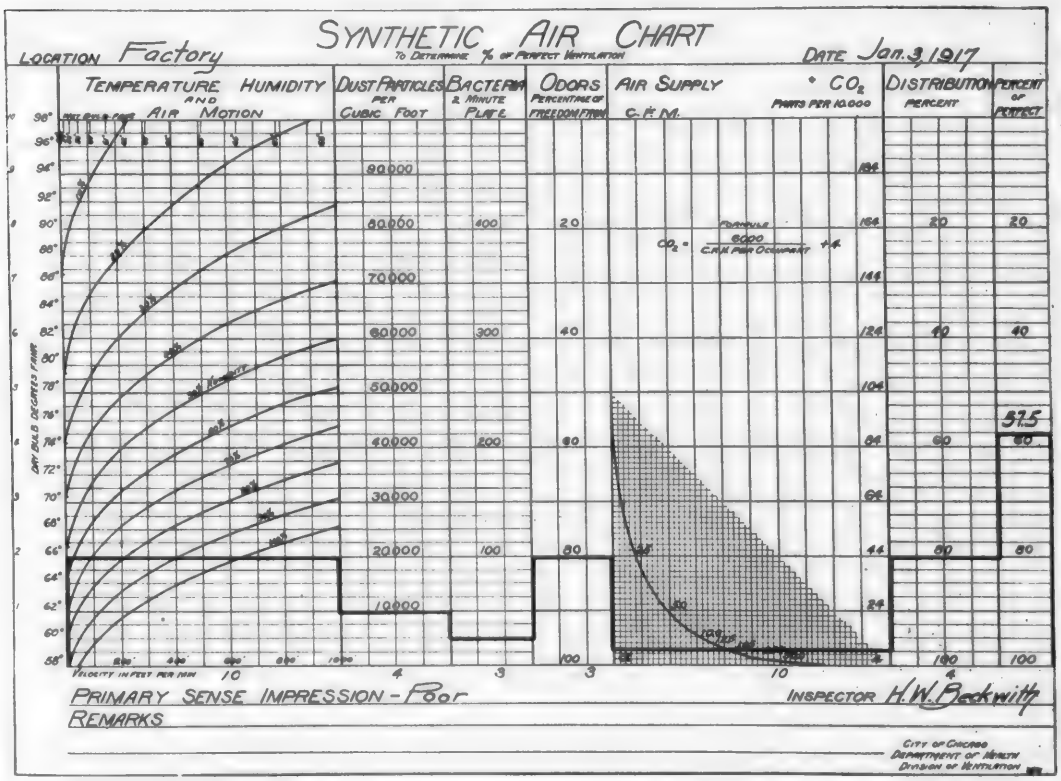


CHART USED IN TESTING INDOOR AIR CONDITIONS.

(Heavy black line running irregularly across chart is printed in red in originals.)

a large number of people, and found to be the points of greatest comfort.

NEW TYPE OF DUST COUNTER.

The new dust-counter, invented by Dr. Hill, patents on which are pending at the present writing, is a carefully built air-pump, which draws into itself and discharges exactly 4 cu. in. of air at each full stroke. Each "pumpful" of air is blown against a glass surface which is covered with a sticky mixture of varnish and glycerine. This surface catches and holds exactly 62% of the dust in the 4 cu. in. of air. Then the sticky glass plate, which has previously been ruled in squares to facilitate counting, is placed under a microscope and the dust particles are counted. To calculate from the number of particles on the plate the number of particles in a cubic foot is a simple matter.

DUST SHOWS BAD AIR.

The ideal conditions require absolute freedom from dust; the more dust there is the worse are the air conditions. The bottom line on the chart, as will be seen, represents the ideal condition.

Then there are bacteria. These are counted by exposing a previously sterilized plate of gelatine to the air for two minutes. If this plate is allowed to stand for a few days, the bacteria will multiply so rapidly that on each spot where a single bacterium fell when the plate was exposed, a large number, or "colony" of bacteria will develop. These colonies, being visible to the naked eye, can be counted quite readily. Freedom from all bacteria, or the ideal condition, is again marked on the bottom line of the chart.

The same is true on the chart for the division marked "Odors," which ranges from "Perfect," or 100% through "Faint" and "Decided" to "Strong" and "Very Strong."

BASE LINE INDICATES IDEAL CONDITIONS.

It will be noticed that in every case, and in every division, the ideal condition is represented on the chart along the base line. Since conditions as found are marked on these charts in red ink, the ideal condition would be represented by a "straight red line" along the base, which is what the ventilation experts are fighting for.

In the chart here reproduced the crooked line which deviates so far from the ideal that the average recorded is only 57.5%, is the ventilation record of a factory.

Fuel Economy with Increased Humidity.

A lively discussion has been going the rounds of the daily press over the value, from a fuel economy standpoint, of moistening the air in heated interiors. One of these discussions arose from a statement made by a correspondent of the New York Tribune that there was a great saving of heat in using lower temperatures and humidifying the air. This led to a rejoinder from Professor William Kent who denied the possibility of such saving, asserting that the cost of evaporating the necessary moisture would overbalance any saving due to a reduction in temperature.

He took as an example a room containing 1,800 cu. ft., and having, in exposed wall surface, 80 sq. ft. of brick and 40 sq. ft. of glass. With an indoor temperature of 62° F. and an outside temperature of 32° F., the heat transmitted through the walls would be 2,160 B.T.U. per hour. If it were zero outside, 4,464 B.T.U. additional heat would have to be supplied. To raise the indoor temperature to 72°, under zero conditions, 720 B.T.U. additional would be needed.

As for ventilation, if two changes of air per hour were allowed, this would be equivalent to 3,600 cu. ft. The heat required to raise the indoor temperature from 32° to 62° would be 1,970 B.T.U., and from zero to 62°, 4,071 B.T.U. The additional heat per 10° higher indoor temperature would be 657 B.T.U. The total additional heat required for heating and ventilating at 72° indoors, would be 1,377 B.T.U.

MOISTURE CALCULATIONS.

If the air is at 62° and 60% relative humidity, 3,600 cu. ft. will contain 1.92 lbs. of water vapor. If outside air has been supplied at zero, it will contain only 0.17 lbs., requiring the evaporation of 1.75 lbs. of water to raise the humidity to 60%. If the outside air is at 32°, it will contain 0.71 lbs., leaving 1.21 lbs. to be evaporated.

The amount of heat at 62° required to evaporate 1.75 lbs. of water is 1848 B.T.U., and to evaporate 1.21 lbs., 1,277 B.T.U.

These figures are to be compared with the 1,377 B.T.U. additional heat required to raise the temperature from 62° to 72°. There is a saving of 100 B.T.U. when the outside air is at 32° F., and a loss of 471 B.T.U. when the outside air is at zero.

The conclusions reached by Professor Kent are questioned in a lengthy rejoinder published in the New York Tribune. The writer, Charles E. Manierre, states that instead of taking the mean average winter temperature and humidity of New York

City for the months of October to April, inclusive, which are respectively 44° F. and 73% of saturation, Prof. Kent's figures deal with the exceptional case of a zero temperature, which only happens three or four times in some winters and in other winters not at all, and the freezing point, 32°, which is only occasional, even during the colder of the months during which artificial indoor heat is provided.

"As to these exceptional conditions Prof. Kent has assumed a minimum difference of 10° between moistened and unmoistened air—viz., 62° for the moistened air and 72° for the unmoistened. This difference would be acceptable in milder weather, for the very reason that there would be more moisture in the air drawn from outside and heated to 72°.

"In zero weather the exceeding dryness of the inside air causes many to allow the temperature to range up to a difference of 20° instead of 10°. This difference would more than wipe out the alleged loss of thermal units through moistening the air which Mr. Kent alleges would take place in zero weather.

"Mr. Kent is evidently wrong in another particular. His letter deals with a room containing 1,800 cu. ft. A medium-sized house, 20 x 50 x 60 ft., would have more than thirty times this cubic content. He suggests two complete changes of air each hour and in zero weather the need of evaporating into this air 1¾ lbs. of water every hour. In a day he would have evaporated 42 lbs., which is the equivalent of rather more than 5 gal., and for a medium-sized house, as above, this would be 150 gal.—considerably more than four barrels of water.

"There is no heating apparatus installed in private houses which would accomplish this remarkable result.

"I have been able to keep the air sufficiently humid in zero weather in a house of approximately the size mentioned by evaporating 9 gal. of water, the amount in ordinary weather varying from 2 to 4 gal. As my house is better ventilated than the average, having a very large skylight with adjustable air openings over the central hallway, I am very certain that it is not deficient in ventilation.

"In the matter of ventilation necessary, it seems, at least in a private house, that a family of perhaps six could get along on less than 2,500,000 cu. ft. of fresh air every twenty-four hours, this being the aggregate amount of two changes of air every hour in a house of the size indicated. As sometimes figured 1,000 cu. ft. an hour a person, this amount of fresh air would last two weeks.

"Accepting the figures of Mr. Kent in his illustration of a room of 1,800 cu. ft. and pursuing the inquiry a little further along the same line, but assuming a mean temperature of 44° F., with a relative humidity of 73% for the outside air, the amount of water necessary to be evaporated to make up the deficiency in moisture, instead of being 1.21 lbs. (with the outside air at 32°, or 1.75 lbs. with the outside air at zero), would be but 0.83 lbs., which would use about 880 B.T.U., showing a saving of 497 B.T.U. That is to say, contrasting the 880 B.T.U. with Mr. Kent's figure of 1,377, the saving would amount to about two-fifths as between supplying moisture and increasing the heat. The total units necessary to bring the temperature up from 44° to 62°, added to the figures necessary to moisten it, would show a saving of coal amounting on the average to about one-sixth of that required without moistening the air.

"My statement that a substantial saving could be made is borne out by a pamphlet setting forth the proceedings of the convention of Weather Bureau officials, which was held at Omaha in 1898, and which contained a paper on this subect by William Wilson, which stated that a 'saving of at least 12½% could be made in the total cost of heating.'

"My house is under medium size. My experience has been that prior to 1907 I regularly purchased twelve tons of furnace coal. I then arranged for moisture in the air, and my furnace coal purchases, beginning with 1907, ran as follows: Eight, eight, nine, nine, nine, seven, six, six, eight and seven tons.

"The reduced amount of coal used by me in the later years is partly due to the fact that within the last six years I have used one-half a ton of pea coal for partially banking the fire when the weather became warm, which has resulted in a further saving. This pea coal is included in the above figures, being bought one ton at a time in alternate years.

"In addition to the above I have used in the furnace in different years an aggregate of perhaps four tons of range coal."

Prof. Kent has now favored us with some additional calculations in support of his position and goes further, stating that his own experience is that a comparatively high temperature without humidifying is better for health and comfort than a low temperature with moisture.

"For over 15 years," he states, "I lived in a furnace-heated house in which water was always kept in the furnace pot, and in one of them there was also a pan of

water under a floor register. For the last 14 years I have lived in houses heated by hot air, steam and hot water, with no humidification, and I prefer the latter condition. While a man may be equally comfortable at 75° F. and 40% relative humidity and 65° F. with 60% relative humidity, I think the tolerance of changes of temperature is much greater at the higher temperatures. With high humidity a slight lowering of temperature produces chilliness, and a slight raising of the humidity, a sticky feeling."

A TYPICAL PROBLEM.

Take for instance, a problem like the following: 1 lb. of air taken in at 0°, 32° and 52° F., 50% and 100% rel. hum., heated to 62° F. and the water evaporated to make rel. hum. 40% and 60%, or heated to 72° F., without moistening. Required the heat added in each case.

Following are the data:

Specific heat of air 0.248. Latent heat at 62° F., 1,057 B.T.U.

B.T.U. for heating 1 lb. of air from:

	Deg. F. 0	32	52
to 62° F.	15.376	7.44	2.48
to 72° F.	17.856	9.92	4.96

That is, in nearly all cases it requires more heat for heating to 62° F. and humidifying to 40% or 60% relative humidity than it does for heating to 72° F., without humidifying.

Novel School Ventilation Scheme.

An instance of the use of burlap ventilators for school rooms is reported by W. A. Conrad, superintendent of the Coloma (Mich.) schools. He states that in one building, which is steam heated, and which did not have sufficient ventilation without the use of the open window and its attendant drafts, he took a hint from the burlap ventilators of poultry houses.

We had our janitor get some strip lumber such as is used in making window screens.

POUNDS OF MOISTURE IN 1 IB. OF AIR UNDER DIFFERENT CONDITIONS.

Temperature, Deg. F.	Relative Humidity, Per Cent 40	50	60	100
0	0.000358	0.000449	0.000539	0.000898
32	0.001498	0.001872	0.002246	0.003744
42	0.002222	0.002777	0.003332	0.005554
52	0.003246	0.004058	0.004870	0.008116
62	0.004684	0.005855	0.007025	0.011709
72	0.006676	0.008346	0.010115	0.016691

MOISTURE IN AIR AT VARYING TEMPERATURE AND HUMIDITIES.

Temp. Deg. F.	0		32		52		62	
Rel. hum. %	50	100	50	100	50	100	40	60
Moisture, lbs.	0.000449	0.000898	0.001872	0.003744	0.004058	0.008116	0.004684	0.007025

Increase of moisture from	0		32		52	
Relative humidity	50	100	50	100	50	100
to 62° F. Rel. Hum. = 40%	0.004235	0.003786	0.002812	0.000940	0.000626	None
Rel. Hum. = 60%	0.006576	0.006127	0.005153	0.003281	0.002927	None
multiplied by 1057 to find B.T.U. for evaporation.						
to 62° F. Rel. Hum. = 40%	4.476	4.002	2.972	0.994	0.662	—
Rel. Hum. = 60%	6.951	6.476	5.448	3.468	3.094	—
Add to these the figures required for heating the air to 62° F.:	15.376	15.376	7.44	7.44	2.48	2.48
This gives for heating and evaporation:						
Rel. Hum. = 40%	19.852	19.378	10.412	8.434	3.142	2.48
Rel. Hum. = 60%	22.327	21.852	12.888	10.908	5.574	2.48
Subtract the figures for heating to 72° F.	17.856	17.856	9.92	9.92	4.96	4.96
Gives the increased heat required for heating to 62° F. and humidifying						
Rel. Hum. = 40%	1.996	1.522	0.492	(—1.486)	(—1.818)	(—2.48)
Rel. Hum. = 60%	4.471	3.996	2.968	0.988	0.614	(—2.48)

Out of this he made frames to fit the upper half of the school room window and covered them with a light grade of common muslin securely tacked. These were fastened outside the upper sash just as an ordinary wire screen would be.

In the morning, after the rooms are warmed, the upper sash can be lowered and an interchange of air takes place without the detrimental drafts. Neither snow nor rain have caused any difficulty so far.

Last spring we were visited by a Red Cross nurse who was at that time touring the county and investigating the sanitary conditions of the schools. She was profuse in her praise of the fresh, wholesome air condition of the school rooms and of the alert, rosy-cheeked student body resulting therefrom.

LEGAL DECISIONS

Requisites of Claim for Lien.

In proceeding to enforce a mechanic's lien, an intervening claim was made for the heating plant which the intervener had installed in the building. It was objected that the claim did not set forth definitely when the labor and materials were furnished. The claim stated that the claimant entered on the performance of the work on or about December 19, 1911, and did the last work on December 17, 1912. It was held that this was sufficiently definite. But the notice of claim did not state the name of the owner, part owner, and lessee. It was held that therefore it did not support an enforcement of the lien, though the name could be supplied by reference to an attached copy of the contract for installing the heating plant and to the pleadings, since the statutory requirement is that the name appear in the claim.—John F. Noud Co. vs. Stedman, Michigan Supreme Court, 160 N. W., 547.

Infringement of Trade-Names.

To constitute infringement of a trade-mark, a literal copy is not necessary, the test being whether the label or mark is calculated to deceive the public and lead them to suppose they are purchasing an article manufactured by a person other than the one offering it for sale. In a suit to restrain unfair trade competition it appeared that the plaintiffs had been engaged in the manufacture of stoves and ranges for many years and had acquired a large business. The articles were sold in connection with certain trade-names which had been registered as trade-marks and used continuously by the plaintiffs. The defendant manufactured repair parts for the stoves manufactured by the plaintiffs, on which abbreviations of the plaintiffs' trade-names were stamped in the same manner as the plaintiffs stamped them. It was held that the plaintiffs were entitled to enjoin the defendant's use of their trade-names and abbreviations thereof. But there was no question of patent rights involved in the case. The manufacture of the articles without any mark indicating that they were manufactured by the plaintiffs was within the defendant's rights. Therefore a decree restraining the defendant from selling or offering for sale parts for use in stoves manufactured by the plaintiffs without informing that they were not manufactured by the plaintiffs was held to be too broad. Scranton Stove Works vs. C. Clark, Pennsylvania Supreme Court, 99 Atl., 170.

The Testing of House-Heating Boilers.

A Discussion.

The following discussion was presented, but not read, at the recent annual meeting of The American Society of Mechanical Engineers, following the reading of a paper on "The Testing of House Heating Boilers, by Prof. L. P. Breckenridge and D. B. Prentice. This paper, practically in full, was presented in The Heating and Ventilating Magazine for December, 1916:

Prof. William Kent: The method of rating a house-heating boiler proposed by the authors seems to leave out a most important factor of such a rating, namely the grate surface, or the amount of coal that should be burned per square foot of grate surface.

The authors say, "The capacity or commercial rating of a heating boiler has always been given in terms of the direct radiating surface which it would serve." The capacity of such a boiler thus defined, that is, the amount of radiating surface which it will serve, is an exceedingly variable quantity, depending chiefly upon the amount of coal that is burned under it per hour, which in turn depends on the size of the grate and the rate of combustion. A certain boiler with 1 sq. ft. of grate and say 20 sq. ft. of heating surface may supply 150, 300 or 450 ft. of heating surface, depending on whether the coal is burned at the rate of 4, 8 or 12 lbs. per sq. ft. per hour. It is evident then that no satisfactory rating of a house-heating boiler can be made that does not take into consideration the rate at which the coal is burned. I therefore

would amend the authors' definition of a unit for stating the capacity of a heating boiler so as to make it read as follows:

The *foot of radiation* shall be ¼ lb. of steam per hour condensed at 212° F., and discharged as water at 182° (equivalent to 250 B.T.U. per hour) when the coal is burned at the rate of 4 lbs. per sq. ft. of grate surface per hour.

S. B. Flagg and R. L. Beers. The writers have been engaged during the past two years in planning and carrying on an extended series of tests which the Bureau of Mines is conducting for one of the Government departments. The principal purpose of these tests has been to obtain information as to the relative value for domestic heating purposes of a large number of fuels used by this department, including a number of Canadian and foreign coals. At the same time a comparison is being made of steam and hot-water boilers.

In the development of plans for the tests which the Bureau is now conducting the following considerations governed:

The average residence-heating boiler operates during the most of the heating season at a load less than 40% of its rating. Results were desired showing the comparative values of the fuels under average load conditions, and the tests were therefore run at approximately this load.

Conditions of attention were to be comparable to those in actual service so far as possible. For this reason with most fuels charges of relatively large size were fired so as to give a firing period ranging from 6 to 12 hours.

In the case of the steam boiler installed in a residence, neither the rate of delivery of steam nor that at which the condensation returns is uniform. The boiler output was therefore allowed to vary, but the valve controlling the delivery was so set that with automatic damper regulation an average load of approximately 40% of rating was maintained. This corresponds with the authors' requirement.

So far as possible the test data were mechanically recorded and some of the data so recorded by a second piece of equipment.

In order to reduce errors of starting and stopping the duration of the tests was made approximately 48 hours.

Measurement of output can readily be made in either of two ways. One way is to send the steam delivered by the boiler through a closed-type feedwater heater, the condensing water circulating in the coil, and measure the condensate. The other way, which would obviate the use of calorimeter readings in computing results, is to measure the quantity and rise in temperature of the condensing water, the condensate returning to the boiler. Selection of equipment for either method may be made from a wide variety, and nearly any desired degree of accuracy obtained in measuring the output.

Roy E. Lynd. There are two points in this paper which I would like to discuss. The first is that the titles of the paper and of the proposed testing code both confine themselves to house-heating boilers, and the paper states that the class of boilers indicated by the authors under this heading includes only boilers designed to serve 2,000 ft. of radiation or less. It seems that we make a mistake in thus limiting this code. The same boilers which we use in our houses are used very extensively to heat schools, churches, and other large buildings, and several makes of low-pressure cast-iron sectional boilers are designed to serve as much as 10,000 sq. ft. of radiation. We would do well to eliminate the term *house-heating boilers* from the title, the paper and the code, and substitute therefor *low-pressure heating boilers;* and include all low-pressure heating boilers instead of those only which are designed to serve 2,000 ft. of radiation or less. The larger boilers of this class are covered by section (9) of the code, which states that the test conditions should be as nearly as possible like the ordinary operating conditions for the boiler to be tested.

In the A.S.M.E. Boiler Code of 1914, boilers are divided into two classes,—Power Boilers, Section 1, and Boilers used exclusively for Low-Pressure Steam and Hot-Water Heating and Hot-Water Supply, Section 2. This division should be borne in mind in any new testing code. As the proposed testing code is essentially a code for evaporative tests, we are not concerned with boilers for hot-water heating and hot-water supply. It would seem therefore that the new code should cover all boilers used exclusively for low-pressure steam heating, and should be so entitled. The A.S.M.E. Boiler Code, in Section 2, does not limit low-pressure heating boilers to 2,000 ft. or less, and we should not so restrict the testing code.

The second point is in regard to the definition given for a *foot of radiation.* The authors seem to think that the amount of steam condensed per foot of radiation enters more largely into ordinary heating calculations than the B.T.U. They have assumed a convenient average amount of steam per foot of radiation, and have then converted this into an awkward B.T.U. value. This, to my mind, is wrong. We figure practically everything in connection with heating installations in B.T.U., and it is very rare that the question of the amount of steam involved is raised. I would suggest that the *foot of radiation* be defined as a transfer of heat equal to 250 B.T.U. per hour. This figure, and its recipro-

cal, 0.004, are both very convenient, and would be far preferable to the figures given by the authors.

It has been the writer's practice to test low-pressure boilers at atmospheric pressure, keeping a record of the steam temperature as indicated by a mercury thermometer placed in an oil well directly in the steam chamber in the top of the boiler. The pressures at which these boilers are operated are as a rule so nearly atmospheric, if the heating system is conservatively designed, that a test made at atmospheric pressure comes about as close to actual operating conditions as it can be got. The great advantage of the atmospheric pressure test is, of course, its simplicity, it being unnecessary to use the reducing valve, receiver, and bank of valves spoken of by the authors.

One of the functions performed by this system of pressure control suggested by the authors is in the determination of the time of starting and stopping the test. The test is started by establishing normal running conditions with a pressure of, say, 5 lbs. on the boiler. Then the fire is cleaned and thinned until the pressure drops to say, 3 lbs., when the test is assumed to start. The same conditions are reproduced at the end of the test, the test being over when the pressure drops to the same 3 lbs. This would all be out of the question with a test made at atmospheric pressure. The writer has used for some time a system which is very similar, and which gives practically the same accuracy, and which is applicable to tests made at atmospheric or any higher pressure. Normal running conditions are established before the test, and then the fire is cleaned and thinned just as outlined in the paper, but instead of depending on the pressure dropping to a certain starting pressure, the temperature of the flue gases is used as an index. When the temperature of the flue gases falls to a predetermined point, the test is assumed to be started, and at the close of the test the starting conditions are reproduced until the flue-gas temperature taken at the same point in the flue falls to the starting temperature. This method seems preferable, as the flue-gas temperature is more intimately connected with the condition of the fire than the steam pressure is, and at the same time it enables us to use the very much simpler atmospheric pressure conditions.

It has also been the writer's practice, for some time past, to keep accurate records of the draft in the flue, in the firebox, and in the ashpit, by means of differential draft gages. These data sometimes indicate differences in the draft conditions which may explain differences in test results.

MAX FRIEDLANDER. Below is a description of a new method for the *continuous* determination of the heat balance of house-heating boilers. The principle of the method was suggested by Prof. H. Junkers, the originator of the Junkers calorimeter, and the method was tried out and applied by the writer in a series of actual tests on a steam-heating boiler in 1911 when he was his assistant at the Technical College of Aix-la-Chapelle, Germany.

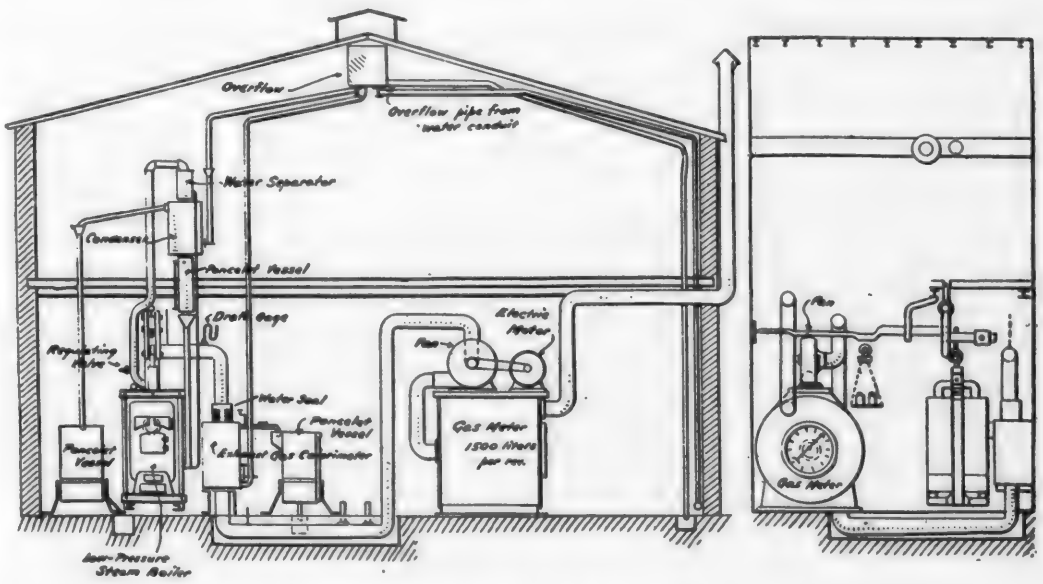


FIG. I—ARRANGEMENT OF TESTING PLANT FOR HOUSE HEATING BOILERS AT AIX-LA-CHAPELLE, GERMANY.

The idea was to measure all items of a complete heat balance in a continuous way during operation, and for this purpose the boiler was suspended upon a sensitive balance, so the smallest amount of fuel burned off in the boiler could be weighed very exactly at shortest intervals, thus giving a continuous determination of the fuel consumption and the incoming heat. The arrangement is shown in Fig. 1.

The entire steam generated was condensed in a condenser and the condensed water carried back to the boiler. In this way the useful heat could be determined continuously by continuously measuring with a Poncelet vessel the quantity of cooling water used in the condenser and, with the thermometers, the increase in its temperature.

The flue gases were drawn out by a ventilator and carried through a flue-gas calorimeter, in which their entire *sensible heat* was determined by cooling them down to the room temperature by a water jacket, the quantity of cooling water being measured continuously with a Poncelet vessel, and its rise in temperature also being measured. The volume of the flue gases was recorded with a gas meter of 1,500 liters capacity per revolution.

A quite novel feature was the continuous determination of the loss of heat due to incomplete combustion by a new calorimetric method in which the heat value of the flue gases was measured in a calorimeter fitted with a specially designed burner for which a patent is pending. This method for the calorimetry of flue gases has been developed by the writer in separate experiments and tried out in a great number of actual tests and applications on boilers and combustion engines, and it has been described in detail in a dissertation (not yet published), where all these experiments and tests are also reported. The arrangement for this is also shown in the illustration.

The heat loss due to incomplete combustion was very variable and, with the boiler mentioned, wavered between 8% and 23% of the incoming heat when the operation and combustion was normal, and increased to over 45% when the boiler was operated with insufficient excess of air or otherwise in bad condition. In all cases, however, the heat value of the flue gases decreased continuously, or, in other words, the combustion improved steadily in the proportion as the layer of coal was burning off, thus indicating that the boiler was working in the beginning like a gas producer.

Heat radiation and conduction was determined by temperature measurements of the outer surface of the boiler and its surroundings, and by use of individual co-efficients of heat transfer.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter Hears a New Definition of Ventilation.

Members and guests of the New York Chapter who attended the February meeting at the Building Trades Club, February 19, were given a treat in the form of two addresses, one on "Deheating Factors of the Atmosphere and Their Measurement," by George T. Palmer, chief of investigating staff of the New York State Commission on Ventilation; and one on "Physiology of Respiration," by Dr. Milton W. Franklin. Both speakers presented their subjects in a manner that held the close attention of the members for over two hours. The meeting was in charge of a committee headed by J. Irvine Lyle, president of the society.

Mr. Palmer, the first speaker, began by offering a substitute title for his address in the form of "Measurement Without the Use of a Yardstick." After referring generally to the work of the New York State Commission, Mr. Palmer said that there are three principal factors we have to deal with in ventilation work, namely, the thermal factor, the gaseous factor and the floating solids factor. Of these, he said, the thermal factor is the most influential because this affects the body and has to do with the method by which the body loses heat. He described the body as a heat-producing engine whose loss of heat is variable, but whose temperature remains practically the same under all conditions. If a fan blows on a thermometer, he said, the mercury does not fall, yet we feel cooler in a room with a fan running, even though the room temperature may be 68° F.

The thermometer, therefore, does not give all the necessary information. We must know about the evaporative quality of the air. As is well known, the pressure of the moisture in a cloth causes evaporation, and in a study of evaporation it will be found that there is a moisture gradient from the wet bulb thermometer to the surrounding air, or, speaking electrically, there is a difference in potential, the air immediately surrounding the wet bulb being more moist than that a little farther away, and so on. It must also be considered that we do not get the rate of evaporation by use of the sling psychrometer.

Mr. Palmer then described a device that was in use for obtaining the quantity of moisture. This is called an atmometer and includes a porus cup fitted with a U-tube. This instrument, however, applies only to objects at the temperature of the air. It must be remembered that in ventilating work

THE ATMOMETER, FOR MEASURING THE DRYING POWER OF THE ATMOSPHERE.

Principal element consists of finger-shaped porous cup, attached to a glass U-tube.

we are dealing with human bodies at a constant temperature of nearly 99° F.

Mr. Palmer described the katathermometer, designed by Leonard Hill (first described in THE HEATING AND VENTILATING MAGAZINE for September, 1915).

A new instrument known as the comfortimeter and designed by Prof. Phelps, was then described by the speaker. This instrument measures the deheating effect of the surrounding atmosphere. In its construction heat is supplied by means of electric resistance coils to a mercury bulb, the bulb becoming heated to above the atmosphere. With the supply of heat constant the bulb is surrounded by a wet cloth and it will then give the amount of heat lost by the air. It is also made up as a recording instrument.

Even with these instruments, said Mr. Palmer, the records obtained do not show what is happening at the feet, but only at the breathing level where they are usually located. The body is something more than a hot object and it is necessary to consider the extremities as well as the main portions.

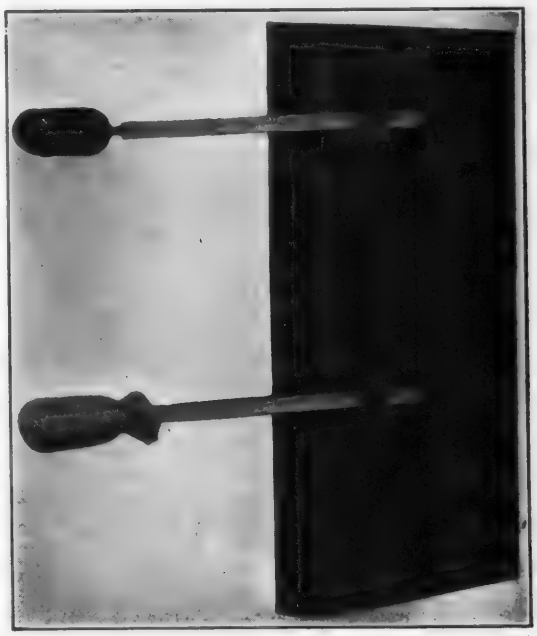
The body, said Mr. Palmer, can also alter its rate of heat loss which adds to the complications.

The speaker gave one plausible reason why outdoor air seems better than indoor air. Out-of-doors, he said, the body meets a fluctuating air movement, but indoors there is usually a steady, unrelenting air movement which affects the body unfavorably. The vaso-motor system may break down under a steady current of air.

Another point that has to be considered when a wet bulb thermometer is used is that the body is not wet or unclothed. Moreover it does not lose all of its heat through the surface but some is lost through the lungs.

In conclusion Mr. Palmer said the engineer must realize all these facts. He is apt to look too much towards achieving mechanical efficiency and not give enough thought to the comfort of the occupants. These two points do not always coincide. The speaker proposed a new definition of ventilation in place of the old one of maintaining a certain standard of air purity. The new definition as proposed is "the adjustment of the air environment to meet the requirements of comfort, health and efficiency."

He added that the work of the commission will probably continue another year before its final recommendations are given out. At that time, however, the commission proposes



THE KATA-THERMOMETER.

For Measuring the Combined Effect of the Three Methods by which Air Extracts Heat from a Hot Object—Radiation, Convection and Evaporation.

to include suggestions for practical applications.

DR. FRANKLIN'S ADDRESS.

Dr. Milton W. Franklin, who followed Mr. Palmer, said that strange as it may seem, the function of the human body is to lose heat. It has been practically disproven that there is anything poisonous in exhaled air and, in fact, there are very few micro-organisms in such air. He also spoke of skin breathing and pointed to the fatal effects that always follow the painting of the entire body, and cited the well-known case of the boy in the Venetian mediaeval fêtes who was covered with gold leaf and placed at the head of the pageant. The fatal effect that always resulted was attributed to unusual virtue and for a long time the real cause was not suspected.

Dr. Franklin gave a very thoughtful discussion of the human anatomy, showing in detail the course of the blood through the arteries to the skin surfaces and back through the veins to the heart, illustrating the part the air plays in serving to keep the blood free from impurities.

In the absence of President Arthur Ritter, the meeting was presided over by Vice-President Frank K. Chew. The report of the nominating committee contained the following nominations: For president, Frank K. Chew; vice-president, C. E. Pearce; treasurer, William J. Olvany; secretary, C. W. Obert; for the board of governors (three to be elected): Conway Kiewitz, George W. Martin, H. G. Issertell, Arthur Ritter, P. H. Seward and A. S. Armagnac.

The report of the entertainment committee which had charge of the entertainment at the annual meeting of the society showed a balance on hand of $178. This will be held by the chapter as a special fund for next year's entertainment.

Ventilation Tests Reported at Meeting of Illinois Chapter.

Ventilation tests made by the Chicago Commission on Ventilation in a modern factory building and in one of Chicago's latest school buildings were reported at the February meeting of the Illinois Chapter, held at the Engineers' Club, Chicago, February 19. F. J. Postel, chairman of the commission, described the tests as made in the Paris Garter Company's factory and in the Lewis-Champlin School, in Englewood. One conclusion reached by Mr. Postel was that modern ventilating systems are basically wrong in that the fresh air supply ducts are almost invariably accumulators of dust. The problem of the future, he said, will be to provide short ducts which can be readily and thoroughly cleaned.

Dr. E. Vernon Hill described his synthetic air chart which is shown on another page of this issue.

National Warm Air Heating and Ventilating Association Adopts Installation Code.

One of the important actions taken at a special meeting of the National Warm Air Heating and Ventilating Association, held in Cleveland, O., January 24, was the adoption of a code to regulate the installation of warm air furnaces. The various points covered in the code are: meaning of the term warm air heating plant; certified heating contractors; permits; concealing pipes or register boxes; round basement pipes; smoke pipes; stacks and registers; cold air ducts; provision for register boxes and stacks; rules for estimating warm air pipe requirements; and furnace casings. The section containing rules for estimating warm air pipe requirement, has the following to say regarding such requirements for 70° F.:

"In no case shall warm-air pipes, extending from furnace be less than 8 in. in diameter. To find the area of warm-air pipes leading from furnaces through which heat is to be distributed to building or rooms contained therein, requiring the maintenance of a temperature of 70° F., with the outside temperature at zero, the following rules are to be used:

"To the area of outside doors and windows expressed in square feet, multiply the result thus obtained by 75. To the result thus obtained add an amount equal to the total cubical contents of the building or room as expressed in cubic feet; divide the result thus found by 80. The result thus obtained will equal the sectional area of the warm-air pipes expressed in square inches."

The meeting was held at the Hollenden Hotel, with President John D. Green in the chair. The report of Secretary Williams showed that the advertising campaign instituted by the association was bearing important fruit in the form of inquiries from consumers. The association has compiled a list of dealers containing some 18,000 names. This list has not yet been published as there is some difference of opinion as to its advisability, and the expense would also be considerable. Secretary Williams admitted frankly that the association is not making much progress in interesting architects.

The executive committee reported, among

other things, on the uniform contract already mentioned; the pipeless furnace, which, it was stated, should be exploited without extravagant and unwarranted claims; the competitive type of furnace, with a recommendation for its elimination; a uniform guarantee and a resolution against selling furnaces direct to users.

A letter was presented from Professor J. D. Hoffman, of the University of Nebraska, containing the following suggestions for improving furnace heating work:

1. Set furnaces low and have a good pitch to leaders.
2. Insist upon larger wall stacks to upper rooms.
3. Insist upon fully enclosed metal return ducts, and eliminate the duct formed by rough floor joists and wall studding.
4. Urge an ample fresh air connection to the return system in every furnace job.
5. Insist upon vent ducts through warm walls from bath room and kitchen to attic, with no returns.
6. Develop humidifying attachments for furnace.
7. And *most important of all* each manufacturer should have follow-up system on each furnace sold, so as to learn if it has been installed to the satisfaction of the purchaser. This would eventually run out the sham furnace dealer, who thinks only of his income, and nothing of the reputation of the manufactured product he handles.

A Handy Chart for Determining the Weight of Pipe.

Since there is so little difference in the weight of wrought-iron and mild steel pipe, the chart shown herewith may be used for either. It is based on 0.283 lbs. per cubic inch, or 490 lbs. per cubic foot. The chart must not be used for calculating cast-iron pipe, however, without remembering that the final result must be multiplied by 0.92. That is, a cast-iron pipe weighs only 92% as much as a wrought-iron or mild steel pipe of the same dimensions.

For example, what is the weight of a wrought-iron pipe line 100 ft. long, 5 in. internal diameter and ⅛ in. thick.

Run a straight line from the 100 (column A) to the sum of the diameter and thickness, 5.125 in. (column E) and locate the intersection with column B. From that point of intersection now run over to the thickness 0.125 in. (column D) and the answer is found to be 700 lbs. in column C. If the pipe were cast-iron, the weight would be 700 x 0.92 = 644 lbs.

The range of the chart, it will be noted,

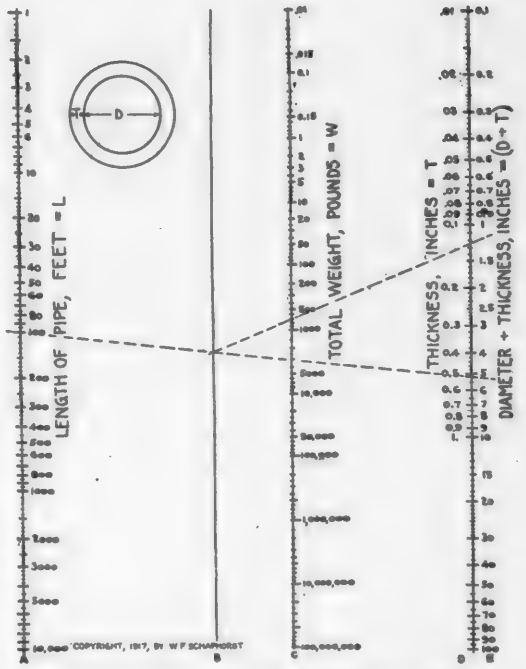


CHART FOR FIGURING WEIGHT OF PIPE.

is great enough to care for any ordinary problem and for most extraordinary problems. It will handle lengths of pipe up to 10,000 ft. and diameters up to 100 in. Where thicknesses are greater than 1 in., the user will have no difficulty in learning how to extend the capacity of the chart to a thickness of 10 in. Thus, a wrought-iron pipe 10,000 ft. long by 100 in. inside diameter by 10 in. thick would weigh very close to 100,000,000 lbs.—*W. F. Schaphorst.*

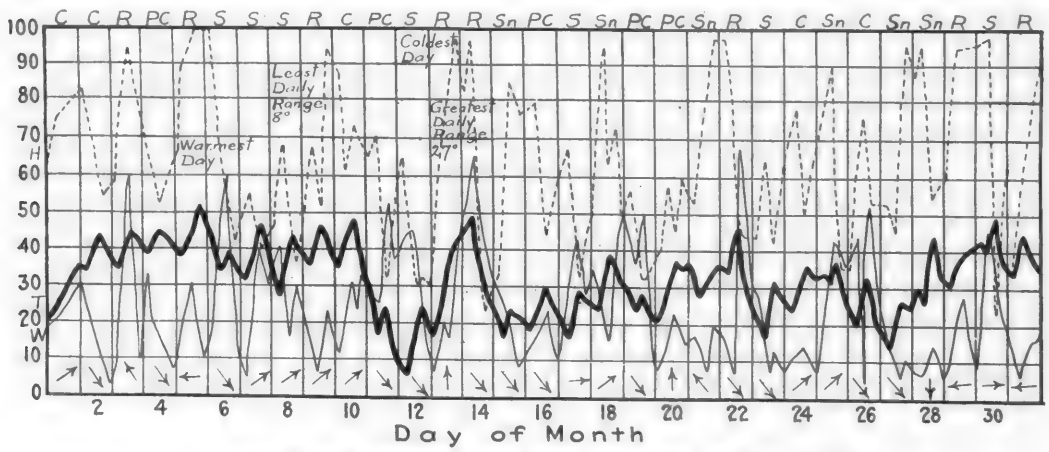
Twenty Miles of Byers' Pipe Used in William Penn Hotel.

In the account, published last month, of the general mechanical equipment of the William Penn Hotel, Pittsburgh, Pa., the important fact was omitted that approximately 20 miles of Byers' wrought-iron pipe and nipples, made by the A. M. Byers Co., Pittsburgh, were used in this installation. This hotel was designed and constructed by Pittsburgh interests, attesting to the reputation of Byers pipe in the Steel City.

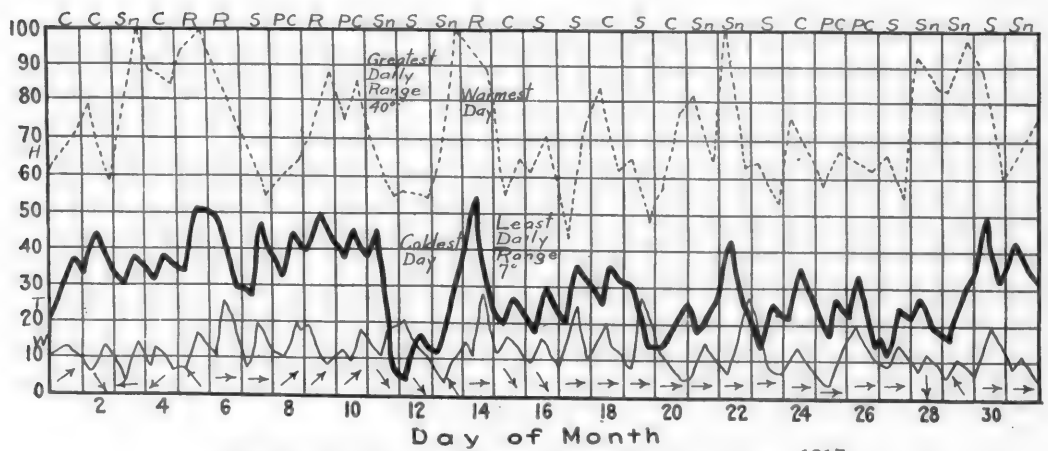
E. W. Pennrich has been appointed advertising manager for the Bishop-Babcock-Becker Co., Cleveland, O., manufacturers of the Reliable line of vacuum and vacuvapor heating equipment. Mr. Pennrich will have entire charge of the company's vacuum heating advertising as well as of its other lines.

The Weather for January, 1917

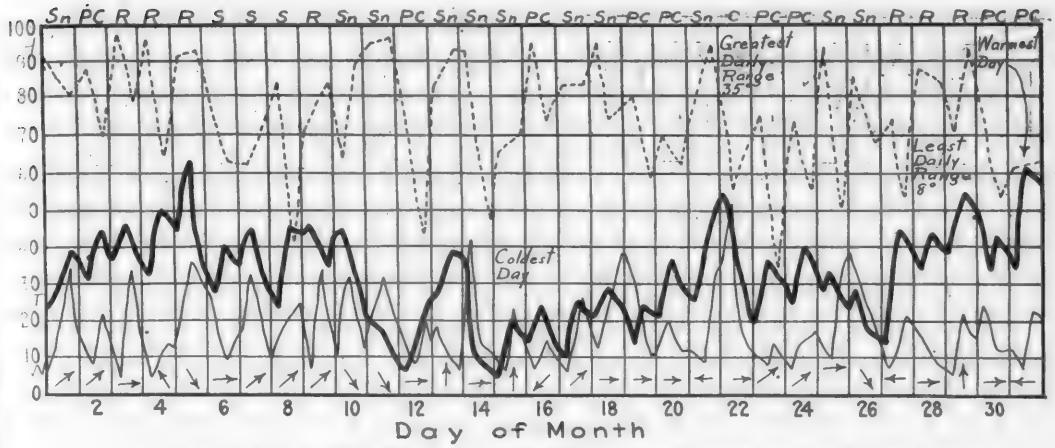
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	52	55	62	47	65
Date of highest temperature	5	14	31	29	21
Lowest temperature, degrees F.	7	5	5	—4	11
Date of lowest temperature	12	12	15	14	14
Greatest daily range, degrees F.	27	40	35	27	50
Date of greatest daily range	13	11	22	10	31
Least daily range, degrees F.	8	7	8	6	7
Date of least daily range	8	15	28	20	15
Mean temperature for month, degrees F.	32.4	30	32	24.2	34.8
Normal mean temp. for month, deg. F.	30.2	27	30.7	23.7	31.0
Total rainfall, in.	2.44	2.82	4.33	1.55	1.72
Total snowfall, in.	5.9	13.6	8.7	9.9	2.5
Normal precipitation, this month, in.	3.79	3.82	2.87	2.0	2.27
Total wind movement, miles	14389	8320	9340	10483	10778
Prevailing direction of wind	N.W.	W.	S.W.	S.W.	N.W.
Average hourly wind velocity, miles	19.3	11.2	12.6	14.1	14.5
Number of clear days	7	9	3	18	9
Number of partly cloudy days	8	5	13	5	13
Number of cloudy days	16	17	15	8	9
Number of days on which rain fell	14	12	18	7	8
Number of days on which snow fell	6	8	11	4	1
Snow on ground at end of month, in.	None	0.6	None	Trace	None



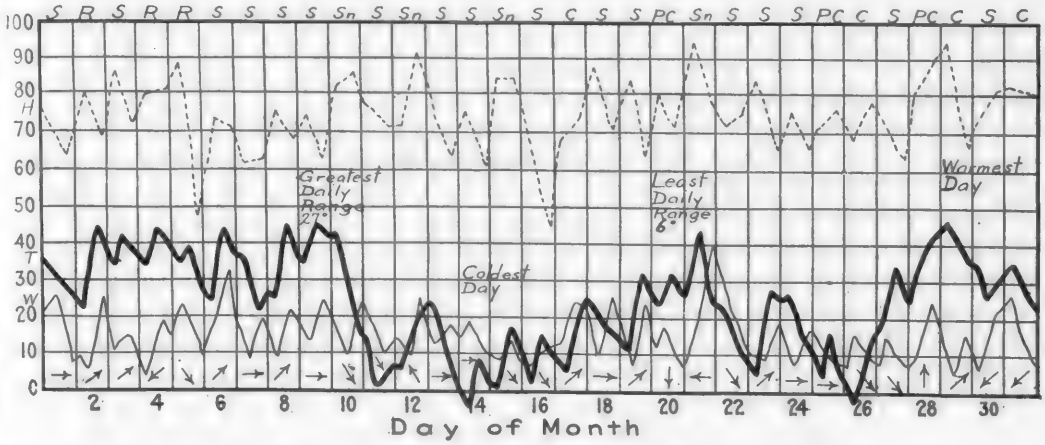
RECORD OF THE WEATHER IN NEW YORK FOR JANUARY, 1917.
(Hourly Observations of the Relative Humidity Are Recorded on this Chart.)



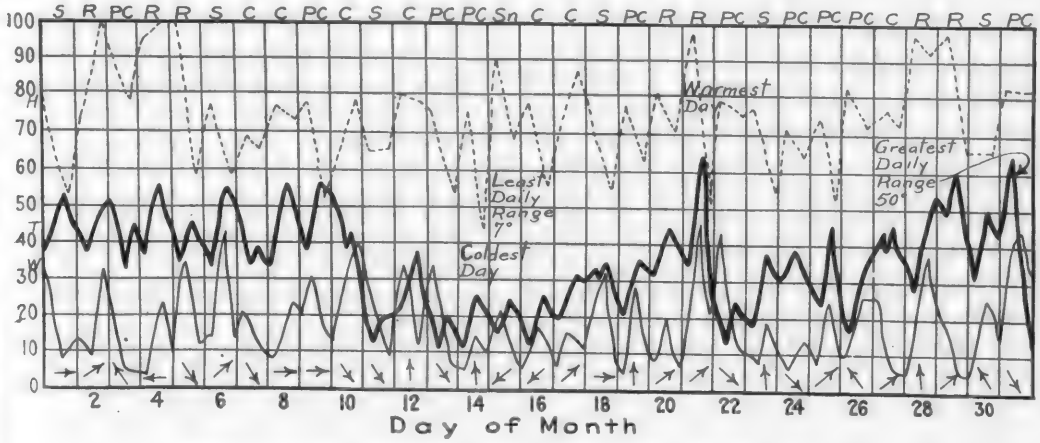
RECORD OF THE WEATHER IN BOSTON FOR JANUARY, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR JANUARY, 1917.



RECORD OF THE WEATHER IN CHICAGO FOR JANUARY, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR JANUARY, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

CORRESPONDENCE

Handling Cotton Lint.

EDITOR HEATING AND VENTILATING MAGAZINE:

The writer is at present engaged in the design of a collecting system for collecting and disposing of a finely-cut up cotton lint, produced in the operation of knitting machinery. The principal difficulty so far met is the collecting of same, rather than the receiving of it after it leaves the suction fan. The system consists of a number of 2-in. ducts feeding into a tapered duct from 3 in. to 7 in. in diameter, from two directions and continued with one 10-in. tubular duct to a Buffalo No. 5 fan in basement, a distance of approximately 20 ft. A Spray Engineering Company's No. 2 nozzle is inserted in the discharge end of the fan, but it does not seem to properly moisten the lint, as expected. Can you recommend a particular nozzle that would do so? Also, what kind of an exhaust chamber would be necessary, so that the by-product could be gathered and packed at a low cost?

Milwaukee, Wis. P.

A spray nozzle at the discharge of the fan is hardly of any practical value, owing to the high velocity at which the air and products are discharged. There is no time for the spray nozzle to moisten them.

For an exhaust chamber, there is probably nothing better than a heavy burlap bag into which this material could be blown. The ordinary cyclone collector is not suitable for this purpose. It would have to be built very large and the air would have to escape at a very low velocity to prevent the material from being carried out.

Standard Heating Data Tables.

EDITOR HEATING AND VENTILATING MAGAZINE:

In looking over the "Standard Data Sheets," published in your last issue, I note what seems to be an error in the matter of the losses through the combined brick and sandstone walls for the 12-in. brick sections. You will note that the losses for this column are less than for the 16-in. brick. I also note that the losses through a brick wall, plastered on each side, are greater than for an unplastered brick wall of the same thickness. Is this correct?

Boston, Mass. C.

EDITOR HEATING AND VENTILATING MAGAZINE:

We have the February number of THE HEATING AND VENTILATING MAGAZINE and have looked over the heat loss tables shown on Pages 59, 61, 63 and 65. We can hardly understand how or why the heat loss co-efficient is greater on a brick wall, plastered inside, than it is on a plain brick wall, while the co-efficient for a brick wall, plastered on two sides, is lower.

Wilkes-Barre, Pa. T.

Our correspondents are correct regarding the inconsistency of the heat loss factors given. In covering such a complete line of wall construction, it was, of course, necessary to adopt values as developed by several different authorities. For instance, the co-efficients for the plain brick wall and for the same wall plastered were taken from one set of authorities, including Carpenter, the German government, the Austrian government, Recknagel, Reitschel and others. When it came to the question of a brick wall plastered on both sides and for certain smaller thicknesses of brick wall, it was necessary to go to some other authority. In regard to walls plastered on both sides, it was necessary to consult still another authority. Therefore, the differences mentioned by our correspondents come from accepting certain authorities upon the constructions with which they have experimented and then accepting other authorities for other constructions upon which the first have not experimented. The brick and sandstone co-efficients are explainable in the same way.

Suggestions are asked from our readers as to what they would recommend for changes in the tentative tables presented. Outside of making the tables "look right," there does not seem to be any reliable basis upon which to suggest changes.

National Safety Council Issues "Safe Practices" Leaflets.

The National Safety Council, a prominent accident prevention agency, has a committee of 50 safety experts working out the maximum and minimum requirements in safeguarding. The findings of these experts are being summed up in the council's monthly "Safe Practices" leaflets. Those already issued cover "Ladders," "Stairs and Stairways" and "Boiler Rooms."

The "Boiler Room" leaflet is a publication of eight pages which starts out with the statement: "The first law in the boiler room

is order. The second is care. The third is proper space." Special attention is given to to lighting, elevated runways, floors, storage of fuel, water supply, hot wells, from water supply to boilers, and safety equipment. This is followed by a section on "Operating Rules for Boilers," the leaflet concluding with suggestions for team work and a concise list of "Safe Practices." Details as to this and other phases of the National Safety Council's activities will be supplied to anyone interested by addressing W. H. Cameron, general manager, 208 South La Salle Street, Chicago, Ill.

A. Everly Carpenter, II, Honored at Dinner.

A farewell dinner in honor of A. Everly Carpenter, II, New York manager of the heating department of E. F. Houghton & Co., Philadelphia, in anticipation of his departure for Paris to assume the duties of foreign manager of the company, was given at the Hotel Astor, New York, January 29. The host was the M. K. Bowman-Edson Co., of New York, which represents the other lines of E. F. Houghton & Co., in New York.

Covers were laid for 75 guests. Charles E. Scott, now general manager of the Vapor Heating Company, acted as toastmaster, and the principal address was made by Charles E. Carpenter, president of E. F. Houghton & Co., whose subject was "Philadelphia Scrapple." He spoke principally of the need of preparation for the economic struggle that will follow the close of the European war and stated that one of the reasons for sending his son back to Paris, where he was formerly stationed, was to keep in touch with the industrial situation abroad, with the possibility, he intimated, of the company's establishing a manufacturing plant for its products in France.

Other speakers were the guest of the evening and M. K. Bowman, M. W. Franklin, Frank K. Chew, H. G. Issertell, and John E. Miller, who succeeds Mr. Carpenter as New York manager for the Houghton company's heating line.

Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the aricle mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

FANS

Characteristics of Fan Blades. O. S. Jennings. Ills. 3500 w. Elec. Jl—Dec., 1916. Fans of the propeller or disc type. 20c.

RESIDENCES

Heating and Ventilating Dwelling Houses. C. T. Alfred Hanssen. Read before Soc. of Engrs. 3000 w. Surv'r—Nov. 17, 1916. Heat insulation of importance. 40c.

VENTILATION

Betrachtungen über Mechanische Lüftung. K. Meier. Ills. 3000 w. Schweiz Ban—Nov. 11, 1916. Mechanical ventilation as applied to schools and other public buildings in the United States and Europe. 60c.

Death of Henry Gordon Stott.

Henry Gordon Stott, superintendent of motive power of the Interborough Rapid Transit Co., New York and the New York Railways Co., of New York, died at his home in New Rochelle, N. Y., January 15. He had been ill several months. Mr. Stott was one of the most prominent figures in the field of engineering in this country.

DINNER TO A. EVERLY CARPENTER, II, HOTEL ASTOR, NEW YORK, JANUARY 29, 1917.

Organization of the Braemer Air Conditioning Corporation.

As announced in the January issue, the Braemer Air Conditioning Corporation has been organized to take over the air conditioning department of Warren Webster & Co., Camden, N. J. This includes the good-will, patent rights, engineering data, records and patterns, for the manufacture and sale of Webster air conditioning apparatus for air washing, dust removal, humidifying, dehumidifying, reclamation of materials, cooling and drying; and the Braemer system of humidity and temperature control.

WILLIAM G. R. BRAEMER,
President.

The highly specialized and distinct engineering problems involved in the application of this apparatus have long indicated the advisability of an independent organization for more aggressive expansion and for better attention to the customer's requirements.

It will be the policy of the new corporation to maintain the present engineering standards and high quality of material and workmanship and to extend to patrons the same attention and co-operation as they received formerly. To prospective purchasers the new company offers the advice of men trained in all branches of air conditioning. Ample capital, it is announced, will enable the company to handle large or difficult undertakings.

William G. R. Braemer, president of the corporation, is the inventor of and has secured numerous patents on Webster air washers. For the past nine years he has had entire charge of the Webster company's air conditioning department. He was previously chief engineer of the Buffalo Forge Company. A graduate of the college of Technology, Copenhagen. Mr. Braemer has made air conditioning a life study.

The treasurer of the corporation is Herbert Coward. He was graduated from Cornell University as a mechanical engineer in 1901 and has been actively identified with the heating, ventilating and air conditioning field for the past 16 years. He was for several years manager of the Philadelphia office of the Buffalo Forge Company and recently gave up his position in another air conditioning firm to become associated with the Braemer corporation.

H. A. Tyrrell, secretary of the corporation, is a graduate of the Massachusetts Institute of Technology and has been Mr. Braemer's assistant with Warren Webster & Company.

The corporation maintains an efficient engineering staff among the members of which is E. Nesdahl, a mechanical engineering graduate of the University of North Dakota.

The management of western territory will be in the hands of L. D. Emmert, 1401 Marquette Bldg., Chicago.

Other representatives appointed to date are as follows:

H. A. TERRELL,
Secretary.

H. COWARD,
Treasurer.

Cincinnati, W. C. Green, 310 Provident Bank Building; St. Louis, Hester & Bradley, 1212 Chemical Building; Kansas City, B. Natkin, 304 Finance Building; Indianapolis, Weinshank & Fenstermaker, 821 Hume Mansur Building; Cleveland, T. G. Phegley, 705 Rose Building. Representation is also being arranged in other large cities.

New Books.

THE MODERN FACTORY, treating of factory conditions as they are and as they should be, is the title of an important work by George M. Price, M.D., formerly director of investigation for the New York State Factory Commission and now director of the joint board of sanitary control in the cloak, suit and skirt, and the dress and waist industries, New York City. Dr. Pierce has had unusual opportunities to learn at first hand the conditions and requirements for safety, sanitation, efficiency and welfare work in factories and his comprehensive survey

of industrial conditions takes in the entire country, together with numerous examples and suggestions gleaned from a trip abroad. An entire chapter is devoted to "Air and Ventilation in Factories," which was edited by Prof. C. E. A. Winslow. Another chapter deals with "Industrial Dusts and Dusty Trades," while a third is given over to "Industrial Poisons, Gases and Fumes." The book is one of special interest to owners, supervisors, hygienists and lawmakers. Cloth, 6 x 9 in. xiv—574 pages, 257 illustrations. $4.00 net. Published by John Wiley & Sons, 432 Fouth Avenue, New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

HOW TO MAKE THE BUSINESS PAY, with special reference to the sheet metal business, is the title of a new book by Edwin L. Seabrook, secretary of the National Association of Sheet Metal Contractors of the United States. The book is also intended to apply to the business of heating, plumbing, electrical and building contractors. It contains methods for ascertaining the cost of conducting business, estimating on contracts, bookkeeping, conducting collections and credits, publicity and business correspondence, and securing and retaining customers. The author's long personal business experience in the sheet metal trade is drawn on at length for his criticisms and advice. Size 6 x 9 in. Pp. 173. Price $2.00. Published by Sheet Metal Publication Co., New York, and may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

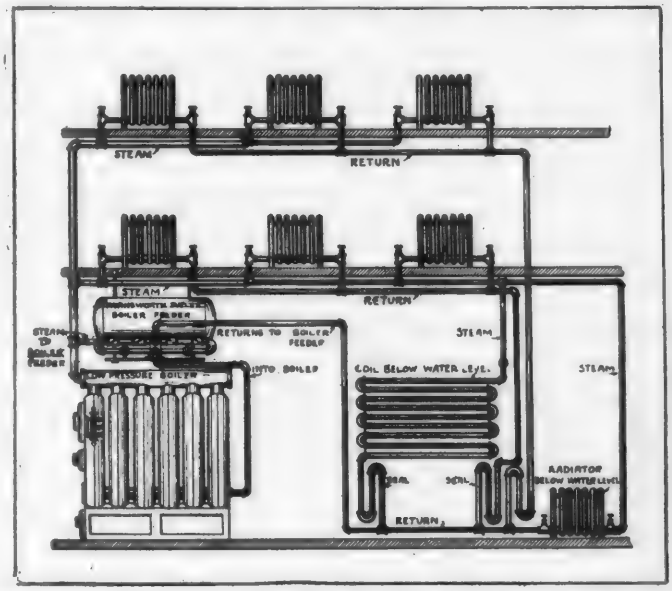
New Publications.

BULLETIN OF THE NATIONAL DISTRICT HEATING ASSOCIATION for January, 1917, contains, among other things, another installment of the history of the association, written by Secretary D. L. Gaskill. The DeWolf and Bushnell administrations are covered in this installment. There is a letter from President Byron T. Gifford regarding the forthcoming convention in Detroit, next June, and there are some proposed changes in the constitution which will be taken up at that time. An interesting description of the high pressure steam line under construction by the Merchants' Heat & Light Co., of Indianapolis, is contributed by G. W. Hubley, general manager and chief engineer of this company.

Use of Farnsworth Duplex Boiler Feeder for Draining Condensation from Apparatus Below Water Line.

The accompanying illustration shows a typical two-pipe low pressure heating system, to which is connected the Farnsworth duplex boiler feeder for draining condensation from radiators or apparatus below the water line of the boiler.

It will be noted that all radiators or coils having return lines that are above the water line of the boiler have a seal at the entrance of the main return line. These seals retard or eliminate possible short circuits between the radiators above the water line of the boiler, and give more free circulation to the radiators or coils below the water line. It



ARRANGEMENT OF FARNSWORTH DUPLEX FEEDER FOR DRAINING CONDENSATION FROM BELOW WATER LINE OF BOILER IN A TWO-PIPE SYSTEM.

is to be noted that the coil shown herewith is half way above the water line and half way below it; therefore, a seal is used on this return connection. As 1 lb. of steam pressure will force water upward about 30 in., it is necessary to maintain a pressure on the boiler of at least 1 lb. for every 30 in. that the boiler feeder is above the lowest radiator. Figuring safely on this covering friction of elbows, pipe, etc., allow 1 lb. pressure for every 2 ft. that the lowest radiator is below the boiler feeder.

This duplex boiler feeder has two chambers. One chamber is always open receiving the condensation from the radiators, while

the other chamber is under pressure, feeding the water into the boiler. The alternate filling and emptying of these chambers tilts the tank back and forth, which operates the control valves.

The boiler feeder does not need to set directly over the top of the boiler, but can be set any place that is convenient; but it must be set at least 2 ft. above the water line of the boiler. The apparatus which is made by the Farnsworth Mfg. Co., Boston, Mass., is positive in its operation and is packless, with the trunnion stuffing boxes eliminated. There are no machined parts in connection with it; floats, levers, weights and all adjustments are eliminated. The apparatus is noiseless, being provided with rubber bumpers.

NEW DEVICES

A New Line of Automatic Temperature Controllers.

In the field of temperature measurement, as applied to industrial works and manufacturing plants, the logical steps are:

(1) To measure and indicate the temperature with a reading instrument; (2) to automatically record the temperature with a graphic recording instrument; and (3) to automatically control the temperature.

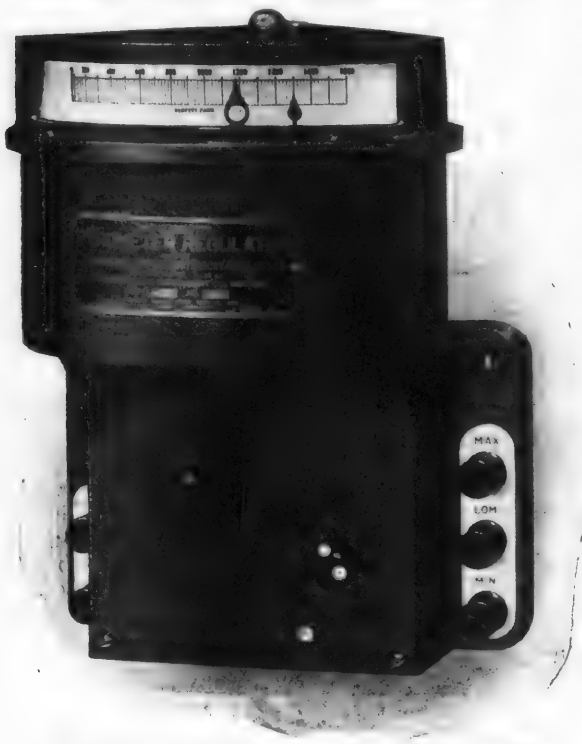


FIG. 1—MEASURING AND CONTROLLING ELEMENTS OF BRISTOL TEMPERATURE CONTROLLER (THERMO-ELECTRIC TYPE).

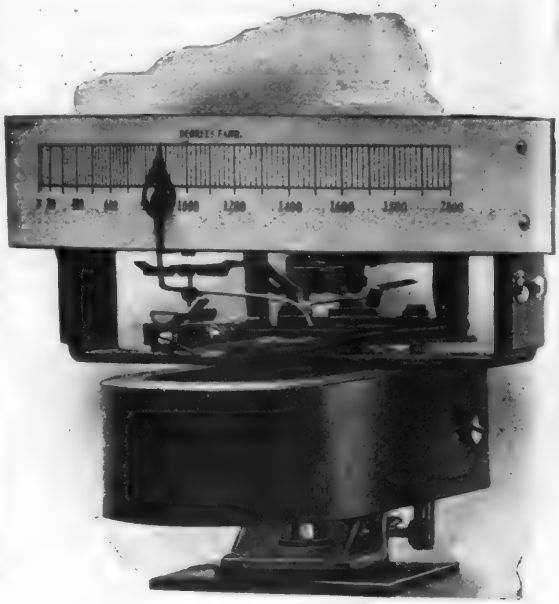


FIG. 2—INTERIOR VIEW OF CONTROLLING ELEMENT, BRISTOL TEMPERATURE CONTROLLER.

At the present time manufacturers are trying to use automatic apparatus wherever possible, thereby eliminating the personal element and there is a demand for automatic temperature controllers in many processes. This situation lends special interest to the comprehensive new line of automatic temperature controllers for gas- and oil-fired and electrically-heated furnaces, brought out by the Bristol Co., Waterbury, Conn.

The principle of operation of these controllers is the use of three elements, measuring, contacting and operating. The measuring element consists of a number of different types of Bristol's electric pyrometers and thermometers. The controlling element is combined with the measuring element and consists primarily of a patented electrical-contact closing device which operates at predetermined high and low temperatures, and closes or opens electrical circuits, thus energizing or disconnecting the operating element. The operating element consists of the device which actually regulates the heat supply in the furnace, as, for instance, in the case of a gas-fired furnace, a pair of electrically-operated gas and air valves.

These controllers can be furnished for all temperatures up to 3000° F.

Trade Literature.

ALBERGER MULTI-HEAD WATER HEATERS are described in a new bulletin (No. 205) just

FIG. 3—INTERIOR OF A BRISTOL THERMOMETER-THERMOSTAT.

issued by the Alberger Heater Co., Buffalo, N. Y. This heater is designed to supply hot water to hotels, laundries, office buildings, apartment houses, hospitals, factories and similar buildings. The shell, tube heads, water channel and the steam and water heads are made of a special grade of cast-iron. The heating surface is composed of seamless drawn copper tubes, the efficiency of which is further increased by helical corrugations, which give the water a swirling motion, increasing the rate of heat transmission as well as keeping the tubes free from scale. All water and steam connections are on the body of the shell, so that it is not necessary to break these connections to secure access to the heating surface. This heater has been

CONSTRUCTION FEATURES OF ALBERGER MULTI-HEAD WATER HEATER.

designed to take care of expansion and contraction. Through the use of the multi-heads each group of tubes is allowed to expand and contract independently. It is a fact that those tubes containing the hot water expand appreciably more than tubes containing cold water. This unequal expansion would cause very serious strains, and oftentimes fractures in the tubes or shells of heaters, unless such expansion strains were properly relieved

The heaters are built for capacities from 200 to 200,000 gal. per hour, in either horizontal or vertical pattern.

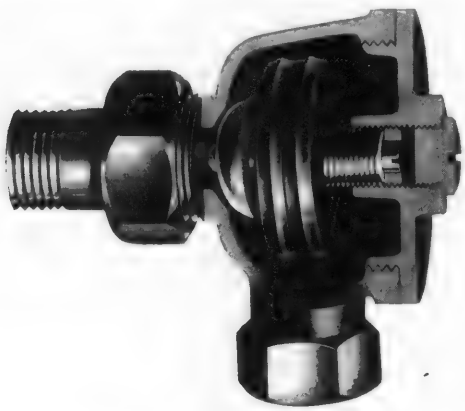
NATIONAL NOVUS BOILERS, manufactured by the National Radiator Co., Johnstown, Pa., featuring the three-piece firepot, are illustrated and described in a new catalogue. This boiler is described as especially adapted for small buildings and residences. It is of rectangular shape, the claim being made that this gives 10% additional heat surface. The corners are slightly rounded to prevent "dead corners." The three-piece firepot feature makes the heater a "one-man boiler" in that it is comparatively easy to handle and erect. More uniform castings, it is stated, can also be obtained in a firepot of three parts. Another unusual feature is the location of the draft door at the left side of the base, high enough to allow the ashes to accumulate without obstructing the air inlet. The catalogue contains complete list prices, ratings, and measurements. Size 6 x 9 in. Pp. 23.

IMICO HOUSE HEATING BOILERS, for steam and hot water, and specialties manufactured by the Illinois Malleable Iron Co., Chicago, Ill., are featured in a recent catalogue devoted to this company's extensive line. The Imico house heating boilers are adapted for burning anthracite coal, bituminous coal, coke or wood. The down-draft series is made for both steam and hot water and ranges from 2,600 sq. ft. for steam to 7,600 sq. ft. radiation for water. In addition to this and the regular line of sectional boilers, the catalogue has a section on the Imico vapor vacuum heating system which includes the Dewey air valve, Dewey vacuum valve, Dewey tri-duty air and vacuum trap and Dewey duplex tri-duty air and vacuum trap. Size 6 x 9 in. Pp. 32.

73% TO 81% VS. 60% EFFICIENCY is the title of a recent folder issued by the Kewanee Boiler Co., Kewanee, Ill., giving data and results of five tests of various Kewanee fire-

box boilers made by Lewis M. Ellison, consulting engineer. The ordinary type of boiler, states the folder, seldom averages more than 60% efficiency. These tests showed that with the regular grate Kewanee fire-box boiler an efficiency ranging from 62.39% to 68.6% could be secured. With Kewanee smokeless boilers the lowest efficiency obtained was 73.86% and it ranged from that figure to 81.38%. Full details of the tests are included, covering some 52 items. Another recent folder issued by this company states that 143 miles of buildings in Chicago are heated with Kewanee steel boilers. It is also stated that for 25 years the company has been making Kewanee boilers of steel and a careful record of repairs shows that repairs average $1.50 a year per boiler.

PECO VACUUM SYSTEM OF STEAM HEATING and its general advantages are covered in a well-designed catalogue issued by the Pittsburgh Engineering Co., Pittsburgh, Pa. The principal elements of this system are the Peco thermal valve, controlling the steam supply to the radiator and designed for one-pipe as well as two-pipe systems; and the Peco vacuum trap for withdrawing the air and water. The company also makes an interesting type of float valve for the same purpose of removing the condensation and air, and other accessories that go to make up a complete modulation and vacuum heating systems. The Peco thermal valve has a diaphragm on the return side of the seat which closes against the steam, instead of being in the steam. This prevents the collapse of the diaphragm through pressure, and also adds to the sensitiveness of the trap. The diaphragm is filled with a chemical liquid when under a vacuum. This insures an even expansion governed by the temperature applied. This expansion member being filled, it cannot be affected by pressure as the fluids cannot be compressed, nor will a vacuum affect it, as the fluids cannot be stretched. A large section of the catalogue is given over to some of the more important installations of the Peco system. Size 6 x 9 in. Pp. 39.

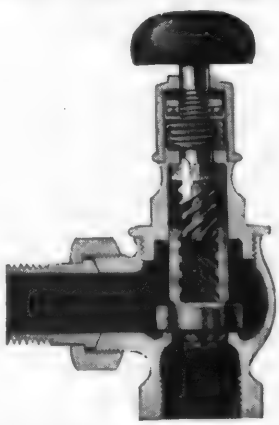


PECO THERMAL VALVE.

HOW TO TELL GENUINE WROUGHT-IRON PIPE is the title of an interesting folder received from the A. M. Byers Co., Pittsburgh, Pa., calling attention also to some notable service records to the credit of Byers wrought-iron pipe. The procedure is to cut three or four sample rings, preferably from different pieces of pipe. Submerge one ring in a solution consisting (by volume) of 25% hydrochloric acid, C. P. 1.19 sp. gr.; 25% sulphuric acid, C. P. 1.84 sp. gr.; 50% water. Leave in solution about 1 min., rinse sample in cold water and then in alcohol. Examine ring at both ends to discover bright streaks, which are indications of steel. Three or four rings cut from different pieces of pipe will usually show steel scrap, if it is present. File a flat on the outside of the ring where the steel, according to the end indications, is most likely to be found. Stop filing when the steel band or bands are half filed away. Re-etch the flat, keeping the sample in solution 1 min. or as long as necessary to bring out the steel bands in strongest relief. If in doubt as to whether or not the bright streaks are steel, polish the surface, etch with 5% picric acid solution in alcohol, and examine under a microscope. Another recent folder issued by the A. M. Byers Company shows an impressive array of Pittsburgh buildings equipped with Byers pipe.

New Design of Dole Packless Radiator Valve.

The accompanying illustration shows the latest design of the Dole packless radiator valve. No change has been made in the principle of the design, but its appearance has been improved by cutting down the length of the stem. This change has been made on the entire line of Dole valves, which are manufactured by the Dole Valve Co., 208 North Fifth Avenue, Chicago, Ill.



NEW DESIGN OF DOLE PACKLESS RADIATOR VALVE.

HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. LOSS PER SQUARE FOOT, PER DEGREE F., PER HOUR).

Terra Cotta or Tile Walls		Temperature Difference, Deg. F.									
	CE	35	40	45	50	55	60	65	70	75	80
Thickness in Inches. Tile, Plain.											
4	0.79	27.6	31.6	35.5	39.5	43.4	47.2	51.3	55.3	59.2	63.2
8	0.56	19.6	22.4	25.2	28.0	30.8	33.6	36.4	39.2	42.0	44.8
12	0.44	15.4	17.6	19.8	22.0	24.2	26.4	28.6	30.8	33.0	35.2
16	0.40	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0
20	0.33	11.5	13.2	14.8	16.5	18.1	19.8	21.4	23.1	24.7	26.4
Tile and Stucco											
4	0.75	26.2	30.0	33.7	37.5	41.2	45.0	48.7	52.5	56.2	60.0
8	0.54	18.9	21.6	24.3	27.0	29.7	32.4	35.1	37.8	40.5	43.2
12	0.41	14.3	16.4	18.4	20.5	22.5	24.6	26.6	28.7	30.7	32.8
16	0.37	12.9	14.8	16.6	18.5	20.3	22.2	24.0	25.9	27.7	29.6
20	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
Tile, Stucco and Plaster											
4	0.34	11.9	13.6	15.3	17.0	18.7	20.4	22.1	23.8	25.5	27.2
8	0.27	9.4	10.8	12.1	13.5	14.8	16.2	17.5	18.9	20.2	21.6
12	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8
16	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
20	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0

Copies of this sheet, printed separately; 5 cents each.

HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. Loss per square foot, per degree F., per hour.)

FRAME WALLS OF—	CE	Temperature Difference, Deg. F. 35	40	45	50	55	60	65	70	75	80
Studs covered as follows:											
1 side L. & P.	0.60	21.0	24.0	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0
2 sides L. & P.	0.34	11.9	13.6	15.3	17.0	18.7	20.4	22.1	23.8	25.5	27.2
1 side Clapboards	0.47	16.4	18.8	21.1	23.5	25.8	28.2	30.5	32.9	35.2	37.6
1 side Clapboards and 1 L. & P.	0.44	15.4	17.6	19.8	22.0	24.2	26.4	28.6	30.8	33.0	35.2
1 side Paper and Clapboards	0.34	11.9	13.6	15.3	17.0	18.7	20.4	22.1	23.8	25.5	27.2
1 side Paper and Clapboards and 1 L. and P.	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
1 side Clapboards and Sheathing	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
1 side Clapboards and Sheathing and 1 L. and P	0.27	9.4	10.8	12.1	13.5	14.8	16.2	17.5	18.9	20.2	21.6
1 side Clapboards and Sheathing and Paper	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8
1 side as above and 1 side L. and P.	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
Clapboards Brick Lined and P.	0.22	7.7	8.8	9.9	11.0	12.1	13.2	14.3	15.4	16.5	17.6

NOTE—L indicates lath and P, plaster.

Copies of this sheet, printed separately; 5 cents each.

HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. Loss per square foot, per degree F., per hour.)

GLASS

	CE	Temperature Difference, Deg. F. 35	40	45	50	55	60	65	70	75	80
Windows— Single-Thick	1.00	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0
Windows— Double-Thick	0.62	21.7	24.8	27.9	31.0	34.1	37.2	40.3	43.4	46.5	49.6
Windows— Double	0.56	19.6	22.4	25.2	28.0	30.8	33.6	36.4	39.2	42.0	44.8
Skylight— Single	1.16	40.6	46.4	52.2	58.0	63.8	69.6	75.4	81.2	87.0	92.8
Skylight— Double	0.48	16.8	19.2	21.6	24.0	26.4	28.8	31.2	33.6	36.0	38.4

Doors Same as single-thickness glass.

PARTITIONS

Wire Lath and Cement Plaster 1½ in.- 2½ in. thick	0.61	21.3	24.4	27.4	30.5	33.5	36.6	39.6	42.7	45.7	48.8
Ditto, 3 in.- 3½ in. thick	0.49	17.1	19.6	22.0	24.5	26.9	29.4	31.8	34.3	36.7	39.2
Corrugated Iron, Unlined	0.84	29.4	33.6	37.8	42.0	46.2	50.4	54.6	58.8	63.0	67.2

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HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. loss per square foot, per degree F., per hour.)

CEILINGS		Temperature Difference, Deg. F.									
Lath and	CE	35	40	45	50	55	60	65	70	75	80
Plaster only	0.62	21.7	24.8	27.9	31.0	34.1	37.2	40.3	43.4	46.5	49.6
Fire proof floor as ceiling	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
Also see "Floors"											
FLOORS											
Dirt	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
Wood on ground	0.10	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
Wood on concrete	0.10	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
Cement on Tile	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
Single Wood on Joists	0.45	15.7	18.0	20.2	22.5	24.7	27.0	29.2	31.5	33.7	36.0
Double Wood on Joists	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
Single Wood L. and P. on Joists	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8
Double Wood L. and P. on Joists	0.18	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	14.4
Concrete on Brick Arch	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
Wood on Brick Arch	0.15	5.2	6.0	6.7	7.5	8.2	9.0	9.7	10.5	11.2	12.0
Dbl. Wood on Brick Arch	0.10	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
ROOFS											
Unlined Slate	0.80	28.0	32.0	36.0	40.0	44.0	48.0	52.0	56.0	60.0	64.0
Slate on T. and G. Boards	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
Iron on T. and G. Boards	0.17	5.9	6.8	7.6	8.5	9.3	10.2	11.0	11.9	12.7	13.6
Unlined Metal Roof	1.30	45.5	52.0	58.5	65.0	71.5	78.0	84.5	91.0	97.5	104.0
Patent Tar and Gravel on Tar and Gravel Bed	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
Tiling 1 in. thick	0.80	28.0	32.0	36.0	40.0	44.0	48.0	52.0	56.0	60.0	64.0
6-in. Tile, 2-in. Concrete and Tar and Gravel Roofing	0.36	12.6	14.4	16.2	18.0	19.8	21.6	23.4	25.2	27.0	28.8
8-in. tile, 1-in. Concrete and Tar and Gravel Roofing	0.40	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0
4-in. Concrete, Cinder Fill and Tar and Gravel Roofing	0.60	21.0	24.0	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0
6-in. Concrete, Cinder Fill & Tar & Gravel Roofing	0.54	18.9	21.6	24.3	27.0	29.7	32.4	35.1	37.8	40.5	43.2

Copies of this sheet, printed separately; 5 cents each.

Binders for Heating and Ventilating Data Sheets.

Binders are now ready for preserving the data sheets on heating and ventilation, which began publication in THE HEATING AND VENTILATING MAGAZINE for February. As announced last month, these sheets should be trimmed along the outer line. When placing them in the binder the left-hand end will serve as a binder-strip. An additional cut-

BINDER FOR STANDARD HEATING DATA SHEETS.

ting line is provided, so that the sheets may be still further trimmed to a size 8 x 5 in., which is a standard size for card-index filing.

It will be noted from the accompanying illustration of the binder that it is substantially made with a spring clip and is bound in brown duck. The cover is suitably stamped in black, instead of gold. The binders may be had at $1.00 postpaid. They are now ready for delivery.

Plan to Establish New York Heating Center in Grand Central Palace.

A project is being developed by the management of the Grand Central Palace, Lexington Avenue and 47th Street, New York, to establish a new heating and ventilating center in that building. The idea is to divide one or more floors into offices, located along the outside walls and reserve the central portion of each floor for a display of heating and ventilating apparatus. Each floor of this building contains 50,000 sq. ft.

The furniture manufacturers' exchange is located in this building and it is proposed to model the proposed new heating exchange on the same general lines.

ADVERTISERS' INDEX

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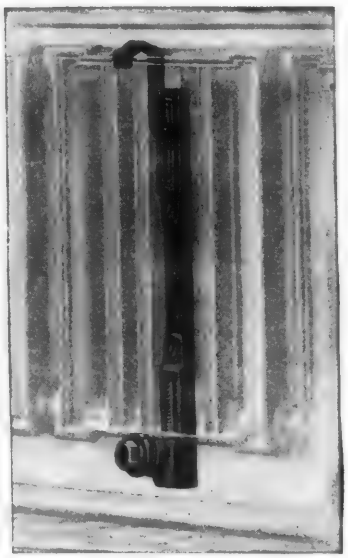
Utilize spare space

The placing of these wall radiators on convenient and non-productive wall space is a gain in appearance and heating efficiency.

Shows how AMERICAN Rococo Wall Radiators can be used in ways never possible with pipe coils

AMERICAN Rococo Wall Radiators

may be assembled to accommodate the shape and size of any wall surface. They are held snugly against the wall by our strong ARCO adjustable brackets. Used in residences, garages, factories, offices, hotels, clubs, churches, theaters, etc.



Shadow view to show how wall radiator is held by new ARCO bracket. This provides for adjustment after radiator is installed

Send for copy of illustrated and descriptive catalog "American Rococo Wall Radiators." Sent free on request

AMERICAN RADIATOR COMPANY

Sales branches and showrooms in all the large cities

TRADE AND MISCELLANEOUS NOTES

Coming Events.

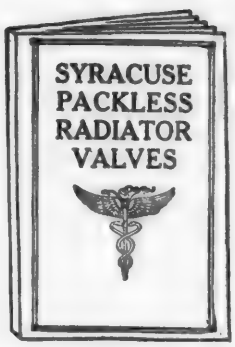
May 21-24, 1917.—Spring meeting of The American Society of Mechanical Engineers in Cincinnati, O.

June 12-15, 1917.—Ninth annual convention of the National District Heating Association, in Detroit, Mich. Headquarters at the Hotel Pontchartrain. Secretary, D. L. Gaskill, Greenville, O.

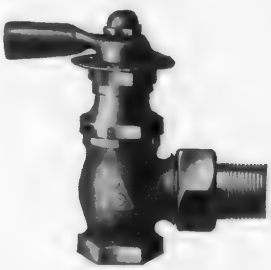
Deaths.

Paul H. Kendricken, of the firm of Ingalls & Kendricken, heating and ventilating engineers and contractors, Boston, Mass., died at the Parker House, Boston, February 5. He was eighty-two years old. Mr. Kendricken saw active service in the Civil War under Admirals Dupont, Dahlgren and Farragut. Soon after the close of the Civil War he formed the partnership of Ingalls & Kendricken, of which he was president and treasurer until his retirement. This firm became one of the largest of its kind in New England. Mr. Kendricken was for years a prominent figure at the conventions of the National Association of Master Steam and Hot Water Fitters, having served on the association's board of governors. Coming so soon after the deaths of Alfred B. Jenkins, Alfred B. Kenrick, and George H. Zellers, all prominently identified with the master steam fitters' association, the death of Mr. Kendricken accentuates to a marked degree the losses this association has recently suffered through death. Mr. Kendricken's last appearance was at the Chicago convention, two or three years ago when he made a patriotic address before the convention. He took an active part in Boston's affairs and had served in the Boston city government and as a State senator. Two daughters and two sons survive him.

THREE NEW ONES



Catalogue


Style 37

Style 38

ALL OF THEM DANDIES!

Send for the catalogue which tells about these new style valves.

SYRACUSE FAUCET AND VALVE COMPANY

Office and Factory
Syracuse, N. Y.

Sweet's Catalogue Page 1249
GEO. A. WELD CO., 79 Milk Street, Boston

220-224 West 42nd St.
New York City

William T. Bassett, a member of the heating and plumbing firm of Howe & Bassett, Rochester, N. Y., died suddenly at his home in Rochester, January 25. He had been engaged in the heating and plumbing business for many years. He leaves a widow who is a sister of Archbishop Edward J. Hanna, of San Francisco. He is also survived by two sons, four daughters and one sister.

Charles T. Holmes, heating engineer and contractor, of Plymouth, Mass., died at his home in that city, February 1. He was seventy-one years old. Mr. Holmes took up heating and ventilating engineering in middle life, but had succeeded in building up an extensive practice in the Plymouth and Provincetown sections of the State. He had always been in the mechanical line, starting as a stationary engineer for the Russell Mills, in Chiltonville. Later he was employed in the Plymouth Iron Foundry and still later was with the Robinson Iron Company, where he had charge of one of the largest engines then in town. He is survived by a widow, one daughter and two sons, Elnahan, engineer at the plant of the Plymouth Electric Light Co., and Harry, who was associated in business with his father.

George Ross, senior partner of the Ross Valve Mfg. Co., Troy, N. Y., died February 9, at his home in Troy. He was 87 years old. The business will be continued by his three sons, William Ross, J. C. Ross and Adam Ross, 2d.

Miscellaneous Notes.

Detroit, Mich.—A campaign for instruction in furnace firing in the public schools was launched at the recent monthly meeting of the Smoke Abatement League of Detroit. Fuel conditions, it was agreed, had made the smoke nuisance in Detroit acute. The committee agreed that Detroit's smoke inspector was overworked. Other cities of this size, it was pointed out, had twelve inspectors. The report of the smoke inspector for the last year showed that he had made 5,632 visits and had obtained 1,399 abatements. It was necessary to take only three cases into court.

Salt Lake City, Utah.—A voluntary commission to supervise the ventilation, heating and sanitary conditions in all public buildings, particularly school buildings, has been proposed by Dr. E. G. Gowans, State superintendent of public instruction. It is Dr. Gowan's plan to have the commission

Reduced Heating Costs

are assured if your clients use a

"RELIABLE" VACUUM OR VACU-VAPOR HEATING SYSTEM

With ordinary steam plants a great deal of coal is burned to create the steam pressure which is necessary to force cold air out of the radiators and piping. If, however, a "Reliable" System is used in connection, the Vacuum Pump creates and automatically maintains a vacuum in the system. Steam is generated at less than 212 degrees Fahrenheit, and is pulled nto all the radiators; and our automatic radiator valves insure all the steam being utilized for heating. These are reasons why "Reliable" Systems reduce fuel bills, and the saving is a big item now that coal is so high in price.

The "Reliable" Trio—Air Line, Return Line and Vacu-Vapor—cover every requirement, and are equally efficient for large or small steam plants in any style of building. Specify them and your clients will be more than pleased.

The new "Reliable" Heating Catalog "H V" contains some valuable information and data. Send for your copy, now—it will prove of interest.

THE BISHOP-BABCOCK-BECKER CO. Cleveland, O.

composed of a member from the board of health, one from the department of public instruction, the State school architect, and, perhaps, one from each of the building trades.

Grand Rapids, Mich.—Members of the Furnace Dealers' Association of Grand Rapids appeared before the council ordinance committee recently to suggest changes in the proposed furnace ordinance. They want provisions made for rigid inspection during the installation of such heating systems.

Fort Madison, Ia.—Owing to the high cost of coal and the scarcity of cars, it is expected that the citizens of Fort Madison will shortly have the opportunity of heating their houses with oil. There is one oil-pipe line passing through the city and it is announced that another will be put through in the near future.

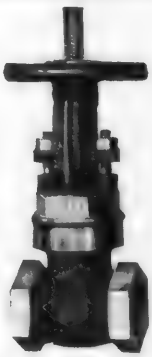
Salt Lake City, Utah.—Regulation of the health and safety of patrons of motion picture houses, theatres and places of amusement is proposed in a bill introduced in the state legislature recently by Assemblyman Cardon of Cache. Mr. Cardon proposes, among other things, that in theatres or places of amusement which seat more than 100 people the proprietor must see that there is 30 cu. ft. of fresh air furnished by a ventilating system every minute for each patron in the theatre. Provision is also made in the bill for the proper construction of the booths for motion picture machines.

Pittsburgh, Pa.—Recent difficulties in heating some of the public school buildings in Pittsburgh were remedied in one instance (the Douglas School) by changing a 24-in. belt wheel driving the blower to a 32-in. wheel. Although this reduced the air supply, it was found that there was enough air admitted to meet the requirements.

Lansing, Mich.—In response to complaints from many cities in central Michigan, Labor Commissioner James V. Cunningham is completing an inspection of foundries, with special reference to the use of salamanders, open-air stoves burning charcoal, which give forth noxious gases throughout the factories. Alibis offered by foundry owners are that a large proportion of the foundries are heated by steam, and the shortage of coal has made it impossible to heat with the usual heating system so that the salamanders became a last resort to keep the plants running.

Chicago, Ill.—Statistics obtained by the *Banker, Merchant and Manufacturer* (Chicago) show that never before in the history of Chicago have there been so many industrial buildings erected in that city as during the last twelve months, and the prospects are that the ratio will be greatly increased. In most cases these are the result of business expansion.

Cleveland, O.—1-cent current for heating and 3-cent current for lighting is proposed for Cleveland in a report to the city council made by Lighting Commissioner W. E. Davis. Mr. Davis proposes that the heating



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Distinct in design, accurate in workmanship, interchangeable construction, metal of the best quality. Made in every size and style, in Standard, Medium and Extra Heavy Patterns, with Inside Screw, Stationary Spindle, or Outside Screw and Yoke, Rising Spindle; furnished in cast steel, iron or brass, the latter rough, polished or nickled; with hand wheels of wood, iron or brass.
There's a Jenkins Bros. Gate Valve that will meet your requirements. Consult catalog No. 20.

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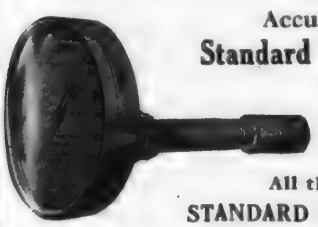

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Standard Indicating and Recording Thermometers
GUARANTEED CORRECT
Full line includes seven types of recording thermometers and a special line for mechanical uses
Indicating mechanical thermometers are furnished with extensions from 2 to 30 in. in length
All thermometers are double and not breakable

STANDARD THERMOMETER COMPANY, Clinton and Shirley Streets, Boston, Mass.

and lighting problems of the city be solved at one time by the lease or purchase of coal lands and the erection of an immense municipal power plant at the mines. Current would be sent from the mines to Cleveland over high-tension lines. "We could sell current at 1 cent per kilowatt hour for heating purposes and the price for lighting would be 3 cents per kilowatt hour," he states. At this rate it would cost $15.00 per month to heat a small home during the coldest months. Heating of larger homes would cost between $25.00 and $30.00 per month.

New York.—The following officers were elected at the annual meeting of the Alumni Association of the New York School of Heating and Ventilation: President, E. A. Kingsley; vice-president, A. H. Bosworth; second vice-president, J. Timmerman; secretary-treasurer, A. D. Hoxie; assistant secretary, George B. Steinke; trustees: Frederick A. Rupp, J. Barton Garfield and H. W. Curry.

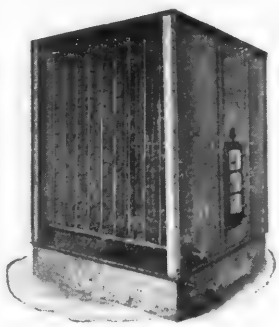
Building Operations for December and for 1916, as compiled by *The American Contractor* (Chicago), make a remarkable showing. For each month of 1916 there was an increase over the corresponding month of 1915. For several months the increase was slight, but 1916 was always on the upgrade side. The official reports of building permits issued in 104 cities total, for December, $69,569,206, as compared with $66,508,718 for December, 1915, an increase of 5%. The showing for the year 1916 is altogether satisfactory. The complete returns received from 94 principal cities yield an aggregate of $904,071,701, as compared with $737,989,150 for 1915, an increase of 22%. Of the 94 cities 74 show gains and only 20 show losses.

New York.—Construction work on the new Hotel Commonwealth, which will be located in the Times Square district, will begin shortly. The estimated cost of the building is $15,000,000. It will be 28 stories high and will contain 2,500 rooms, all with baths. It is announced that the radiators for the hotel will be of American Radiator Company make. C. H. Ingersoll is president of the company building the hotel. It will be constructed under the single-contract building method by W. J. Hoggson.

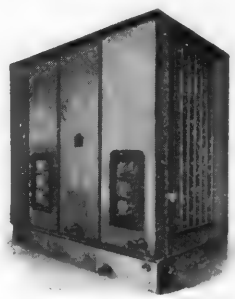
Eastern Supply Association, at its meeting in the Hotel Astor, New York, February 15, was addressed by Otto G. Hitchcock, secretary of the Hays Mfg. Co., Erie, Pa., who spoke on "Efficiency Club Work in Our Organization."

Central Supply Association held its winter meeting in Chicago, February 28, at the Congress Hotel.

19 More Installations of Webster Air Washers



were furnished for the Public Schools of Philadelphia during 1916—after several years' experience with previous installations.



Public and industrial buildings served by Webster Air Washers are assured of a dependable supply of clean, pure air at nominal cost, and when provided with our automatic control system, Webster Washers also maintain any desired temperature and humidity.

Ask for our engineering advice and estimate

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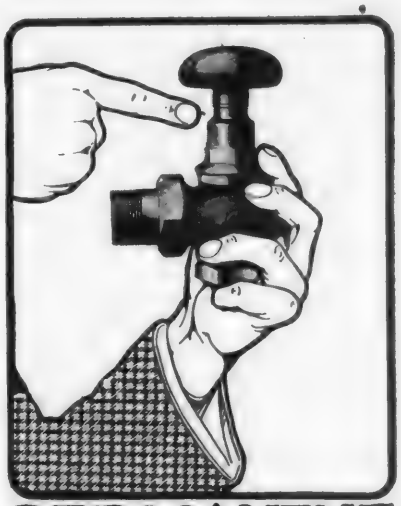
Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

DETROIT PACKLESS RADIATOR VALVES



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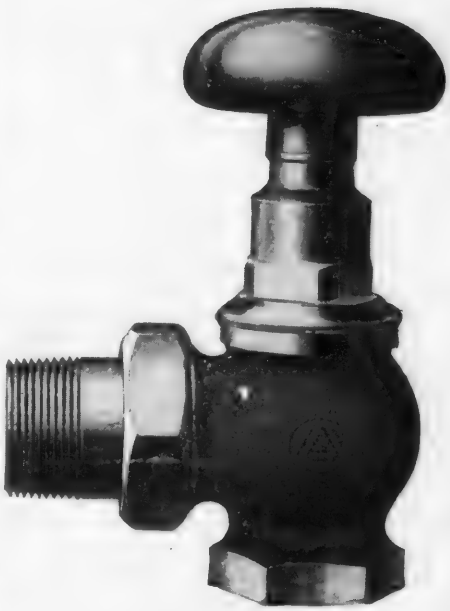
• NICKEL •
TRIMMINGS



Detroit Packless Valve trimmings are nickeled before being assembled. The plate is extra heavy, and by a special process is made as permanent as the valve itself.

No other valve is so handsomely plated or has such lasting lustre

Specify Genuine Detroit Packless Valves

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CANADIAN DETROIT LUBRICATOR COMPANY LTD WALKERVILLE, ONTARIO

LARGEST MANUFACTURERS OF RADIATOR VALVES IN THE WORLD

Central Station Heating Notes.

Anderson, Ind.—Another shakeup in the management of the Central Steam Heating Company has resulted in the retirement of E. M. Bendure, of Sedalia, Mo., as manager. Otis P. Crim, a large stockholder in the company, is again in charge. It is said that dissatisfaction among the stockholders growing out of the recent "breakdowns" at the plant was responsible for the change. Mr. Bendure assumed management of the plant last September. He was given the management of the plant on the basis that he was to receive all moneys over and above a certain amount stipulated by the stockholders as a reasonable return on the investment. The boilers of the plant have been a source of trouble since their installation and are believed to be practically responsible for all the difficulties of the company. Extensive repairs at the plant are being planned for next summer. Mr. Bendure is manager of a central heating plant at Sedalia, Mo., and had been dividing his time between the two cities. The common stockholders of the Central Steam Heating Company, which represents an investment of $150,000, are Jesse L. Vermillion,. Myron G. Reynolds, Otis P. Crim, Allen Richwine and the Brunt Estate.

DANIEL S. WHITE PRESIDENT
JOSEPH W. MOTT MANAGER

HOTEL TRAYMORE
ATLANTIC CITY, N.J.

November 28, 1916.

Ilg Electric Ventilator Company,
327 Commercial Trust Building,
Philadelphia, Pennsylvania. Attention of Mr. C. A. Anderson.

Dear Sir:

In reply to yours of November 24th, concerning service which we have received from Ilg fans, beg to state that we have several of them in operation, all direct connected motor driven, and that they are giving perfect satisfaction. We wish to take this opportunity of expressing our appreciation of the well built commutators of your armatures, as we have fans that have been in operation about sixteen months and the commutators are practically unworn. When we compare these with other motors of first-class make on which we have turned down the commutators once or twice in the same period of time, it makes us feel that there must be particularly good material and workmanship in your product.

Yours very truly,

GBC/HK. HOTEL TRAYMORE,
SUPT. OF PROPERTIES.

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LARGEST RESORT HOTEL IN THE WORLD
SAYS ABOUT

ILG Universal Blowers and ILG Self-cooled Motor Propeller Fans

This installation includes 6 direct connected Universal Blowers, sizes 45" to 90", and 10 Self-cooled Motor Propeller Fans.

ILG ELECTRIC VENTILATING CO., 158 Whiting St., Chicago

ELKS' TEMPLE, TACOMA, WASHINGTON. ARCHITECT: E. FRERE CHAMPNEY, SEATTLE, WASHINGTON. CONSULTING ENGINEER, ERWIN WEBER, SEATTLE, WASHINGTON. HEATING CONTRACTORS, APPLING-GRIGGS COMPANY, TACOMA, WASHINGTON.

Elks' Temple in Tacoma, has

Sturtevant
(REG. U. S. PAT. OFF.)

Apparatus

The Elks' Temple is another example of a first-class, up-to-date, American Building, equipped with Sturtevant Apparatus. This is just one of thousands that are so equipped as Sturtevant Fans, Heating Coils, and Air Washers, are specified by the majority of architects and engineers.

Let us send you Catalog 230-V on Heaters, or Catalog 226-V on Air Washers

B. F. STURTEVANT COMPANY

HYDE PARK, BOSTON, MASSACHUSETTS

And All Principal Cities of the World

Stationary Vacuum Cleaners, Air Washers, Fans, Heaters, Motors

Luverne, Minn.—Preliminary action has been taken for the installation of a central heating plant at Luverne during the coming summer. Several weeks ago the city council submitted to the Commercial Club a report of certain investigations into the feasibility of such a plant, to use exhaust steam from the municipal power plant. The Commercial Club has now appointed a committee to proceed with the organization of a company to finance the plant. According to present estimates it is believed that the amount of steam available will be sufficient to supply heat to a majority of the buildings in the business district. The plant will be of sufficient capacity to supply the entire business district. Mr. Larsen, the St. Paul representative of the Milwaukee Conduit & Insulation Company, addressed the members on the general subject of central station heating.

Spencer, Ia.—Spencer is likely to have a special election to decide whether it will build a municipal heating plant. The city council, after listening to an explanation of the project by W. R. Skinner, a Minneapolis engineer, appointed several of the councilmen to visit a number of cities where such plants are in operation. The present plan is to use the waste steam from the city lighting plant.

Salt Lake City, Utah.—A request has been presented to the city commission that the franchise privileges as to steam heating now held by the Utah Light & Traction Company be extended to the Utah Power & Light Company. It was explained that the purpose of the power company is to engage extensively in the supply of heat for the downtown district, of which 15% is now being supplied under the franchise of the subsidiary company. The matter was referred to the committee of the whole for consideration.

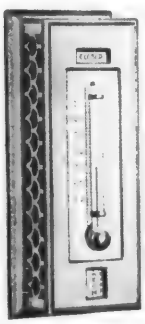
Grinnell, Ia.—The new $100,000 plant of the Grinnell Electric & Heating Company is nearing completion, in spite of numerous delays caused by the severe winter weather. Two batteries of boilers have been put in their places. They have a capacity of 1,200 h. p. and will be operated at 100% overload, giving a complete capacity of 2,400 h.p. They are Erie boilers of the Union Iron Works manufacture.

Cleveland, O.—In connection with the repaving of the streets of Cleveland, Councilman Sulzmann is drafting a proposed ordinance for an extension of the muinicpal

FIRST IN THE FIELD

Automatic Temperature Control for Buildings Originated with the

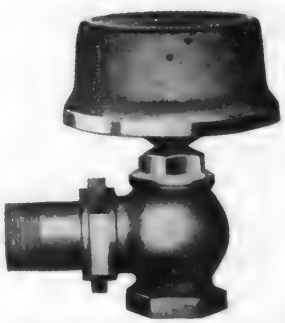
Johnson System of Temperature Regulation



The marvelous little fool-proof Thermostat

While various imitations in the way of regulating devices have been offered to the heating trade, the JOHNSON SYSTEM is the recognized standard.

It costs no more to install the JOHNSON SYSTEM than inferior products, so why assume any risks?



The indestructible sylphon metal diaphragm valve

Communicate with our nearest branch in regard to your temperature regulation requirements
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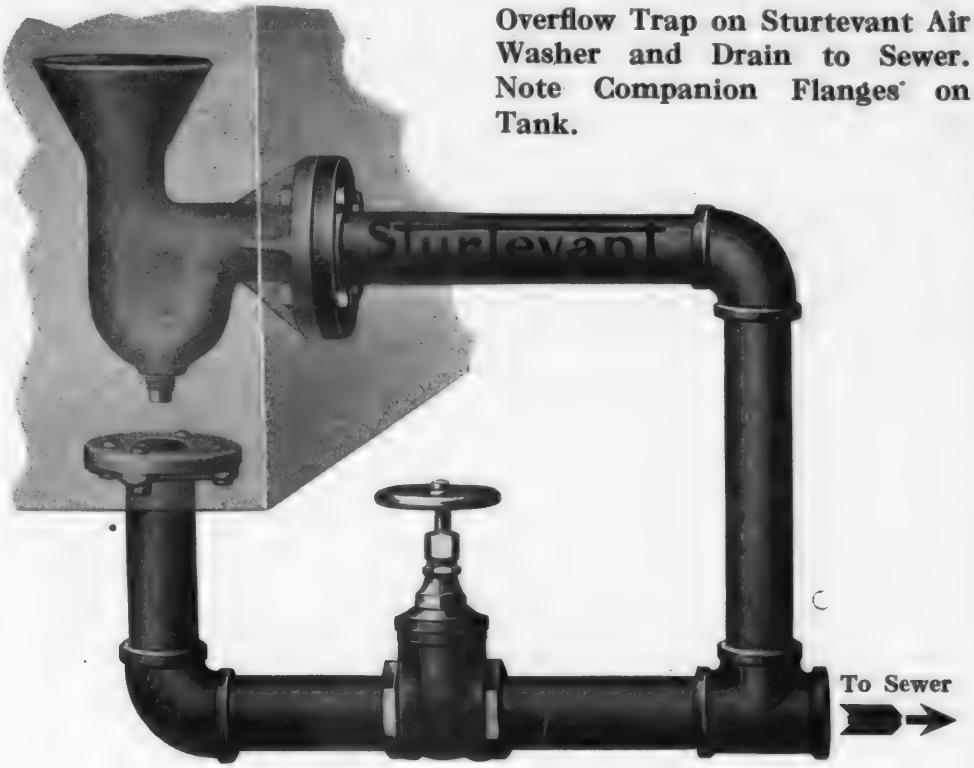

Overflow Trap on Sturtevant Air Washer and Drain to Sewer. Note Companion Flanges on Tank.

Sturtevant
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AirWashers

are equipped with a trap. This completely eliminates any possibility of the fans sucking odors and sewer gases from the drain pipe into the spray chamber.

Some of the other mechanical advantages of the Sturtevant Air Washers are as follows:

Strainer area more than twice that of any other washer made and ten times the area of some.

Strainer designed for removal for cleaning. No bolts, clamps or latches to be manipulated or to give trouble.

More nozzles per thousand cubic feet of air than any other washer.

Supplies more water to eliminator plates for auxiliary washing than any other apparatus.

Furnished with louver diffuser plates on inlet side.

B. F. STURTEVANT COMPANY

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Stationary Vacuum Cleaners Air Washers Fans Heaters Motors

heating system in that city. "During the next four years," he says, "Cleveland's streets will be torn up for repaving at an expense of close to $10,000,000. The steam pipe line should be put down at the same time to save the vast expense of tearing up the pavement at some future date. The heating system should be based on the existing municipal heating plants at Fairmount, East 53rd Street, and Collinwood substations to be built in connection with the Kirtland water works, the Division Street pumping station, the old work-house power substation and the old South Brooklyn power station." It is stated that the East Ohio Gas Company, even now, is unable to supply the demand, owing to the partial exhaustion of the West Virginia gas fields. Councilman Sulzmann's proposed ordinance includes a $15,000,000 bond issue to cover the expense involved.

Des Moines, Ia.—The city council instructed the legal department to draft a heating franchise and to prepare for a special election on it, to be held during March. Representatives of commercial and civic organizations appeared before the council with a demand for a franchise to permit the Des Moines Electric Company to operate such a plant. They declared that public sentiment is now for the measure. At the last election on this proposition the proposed franchise was defeated. J. A. McKinney, president of the Des Moines Commercial Association, which formerly opposed the project, stated: "We were against the franchise a year ago because no provision was made for serving the east business section. As this is now provided for, I am confident the proposition will carry." L. E. Harbach, representing the smoke commission and the town planning commission, said the need is imperative, as it is the only way to solve the downtown smoke problem. The new draft of the proposed franchise provides that it is to run for 25 years, that the city is to supervise the laying of mains, etc., and that construction work is to begin as soon as the franchise passes. Provision is made for serving both sides of the river (downtown). The schedule of rates is fixed with a maximum of 80 cents per 1,000 lbs. of condensation and a minimum of 50 cents per 1,000 lbs. The company's books must be open to the city council. Heat is to be furnished from October 1 to May 15. The city can purchase the plant after eight years and up to within one year of the time when the franchise expires. The company must furnish an indemnity bond of $25,000.

Temperature Regulation Made Practical

ONE prime requisite in any temperature regulation is that it shall operate for the layman as surely as for the engineer—it must be practical.

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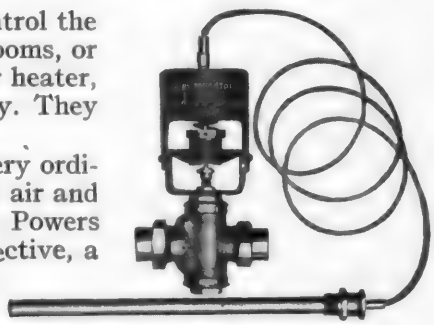
There is a specific Powers Regulator for every ordinary requirement in the automatic control of air and fluid temperatures, and as the fundamental Powers principle is practical, comprehensive, and effective, a Powers Regulator can be adapted for any unusual or difficult condition.



Bring us your problem. We may be able to help you out of a difficulty, or show you a better way, or give you improved results. Our thirty years' experience in this one line ought to be a help.

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BOSTON, 325 The Federal St. Bldg.

IN these days of tremendous business activities—when the innovations of today are to be superseded by still greater accomplishments tomorrow—when methods progress so rapidly that a "standard" ceases to hold its significance; it is gratifying to state that "Sirocco" Heating, Ventilating and Air Conditioning Equipment has kept abreast with unfailing development.

Hundreds of modern industrial plants with their fine array of buildings continue to install "Sirocco" Equipment with the same degree of surety which prompted their first purchase.

"Sirocco" seems to radiate a sense of stability.

The "Sirocco" Trade Mark is clean cut, as much so as the product it represents.

Back of "Sirocco" Products is an Engineering Service. Our Engineers will gladly assist in connection with the application of air handling equipment to meet definite requirements.

May we be of this service to you?
Bulletin No. 2709 upon request.

AMERICAN BLOWER COMPANY

DETROIT, MICHIGAN

West side boundaries for service are named as follows: West Second Street on the east from Grand Avenue to Court Avenue; Court Avenue and Mulberry Street on the south from West Second Street to Ninth Street; Ninth Street on the west from Mulberry Street to Grand Avenue; Grand Avenue on the north from Ninth Street to Second Street. The company agrees to extend service to East Sixth and Locust Streets, providing permission is given to use the Grand Avenue or Locust Street bridges for carrying mains.

Following is the table of monthly rates, based on 1,000 lbs. of steam:

Eighty cents for 20,000 lbs. or less.

Seventy cents for the next 20,000 lbs. or less.

Sixty cents for next 60,000 lbs. or less.

Fifty cents for excess over 100,000 lbs. These rates are to be effective for three years. Five per cent discount is to be allowed if bills are paid within fifteen days after they are rendered.

Davenport, Ia.—Leaky water mains and laterals have required 25% more steam in the city's heating system this winter than last, to furnish the city with heat, according to H. C. Blackwell, general manager of the People's Light Company. In several places about the city it has been necessary to uncover the steam pipes to eliminate the water that has accumulated around the pipes. The company, it is stated, is planning the installation of a new heating system next year.

Goshen, Ind.—A municipal heating plant is being agitated by several prominent Goshen citizens, following the recent scarcity of fuel. Several years ago the project was placed before the city council, but no action was taken. According to local coal dealers it has been impossible to procure hard coal and they have been receiving other grades of fuel only after much delay. It has been retailing at from $9.00 to $11.00 per ton.

Council Bluffs, Ia.—With the temperature down as far as 23 degrees below zero, it is stated that the Brandeis heating plant, in Omaha, which supplies heat to 15 buildings, was not extended to more than two-thirds of its capacity. The plant is located at Seventeenth and Dodge Streets and includes five boilers of 400 h.p. each.

Davenport, Ia.—An amendment to the article of incorporation of the People's Light Company has been filed, providing for the operation of a heating plant for the city of Davenport by the company, and giv-

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Thermometers
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Guaranteed to be correct. Each instrument is thoroughly tested before it leaves our plant, and must remain so in actual service. The most exacting observance of details in production, methods, and the use of the finest equipment make possible the enviable reputation by which Tycos Instruments are known.
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In order that you may obtain truthful thermometer readings, know more about the reasons of Tycos superiority. Write today explaining your requirements.
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The ventilating equipment of this attractive temple is driven by

Westinghouse Motors

The reliability of these motors is demonstrated by the number of prominent buildings in which they are installed.

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Our Experience is at Your Service

Westinghouse Electric & Mfg. Co.

Sales Offices in all Large American Cities East Pittsburgh, Pa.

SEPARATE HEATING UNITS

will solve your difficulties, especially where you have many varying conditions to meet. The

Sturtevant
REG. U. S. PAT. OFF.

Electric Heat Blower

is just the thing for that small room or hall that does not require a large heating unit and which is used only occasionally. The Sturtevant set consists of a motor-driven fan discharging air through heating coils placed in an aluminum casing. Smaller sizes are portable and can be used in a similar way to electric cooking utensils in connection with suitable wiring systems.

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B. F. STURTEVANT COMPANY

Hyde Park, Boston, Massachusetts, and all Principle Cities of the World.

STATIONARY VACUUM CLEANERS AIR WASHERS FANS HEATERS MOTORS

ing it the authority to purchase the plant of the Davenport Gas & Electric Company and to purchase its mains.

Harrisburg, Pa.—The Harrisburg Light & Power Company has been a storm center recently on account of the insufficient heat supply furnished through the company's mains. The company has stated that the fault lay with the individual installations which, the company claimed, were out of order. Patrons claim that the plant is overloaded and that the recent large extensions have been made without providing the necessary boiler capacity. The company has a monopoly of steam heating in Harrisburg.

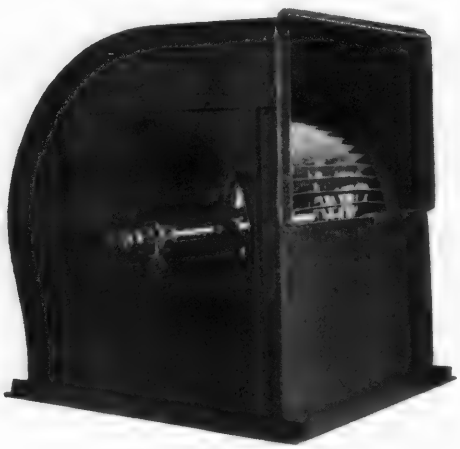
Alva O. Greist, New York, announces that he has opened an office as consulting engineer at 51 East 42nd Street, New York, and that he is prepared to make reports, designs, specifications and estimates for public utility properties, steam power projects, generating plants, and underground distribution systems for central station heating. In an account of Mr. Greist's recent work, published last month, it was stated that he had charge of the rebuilding of the underground system of the New York Steam Company. This was not correct as the entire project of relaying the mains was under the personal supervision of H. A. Austin, president of the Burling Engineering & Construction Company.

Manufacturers' Notes.

Jenkins Bros., New York, announce the election of Farnham Yardley as president of the company, to fill the vacancy caused by the death of Alfred B. Jenkins. Mr. Yardley, who is a son-in-law of the late Mr. Jenkins, was formerly vice-president of the company. Frank T. Swain, general manager; has been elected vice-president. Samuel Laird, manager of the Philadelphia branch, has been elected a director to fill the vacancy on the board. With these exceptions, it is stated, the officers and directors remain the same as heretofore. The interests of Mr. Jenkins as a stockholder of the company will remain intact, under a trust created by his will, for the benefit of his descendants. The policy of the company, as laid down by Mr. Jenkins, will be adhered to and maintained in all departments of the business.

Alberger Pump & Condenser Co., New York, announces that it has opened a branch office in Philadelphia, in the Pennsylvania Building, 15th and Chestnut Streets. The new office will be in charge of H. W. Wet-

Notice This Wheel?



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The blades are set at an angle to the shaft.

Various tests have proven that this fan—

1st—Handles more Air

2nd—Requires less Power

than any Multivane Fan with blades set parallel with the shaft.

IT'S A

CYCLOIDAL MULTIVANE

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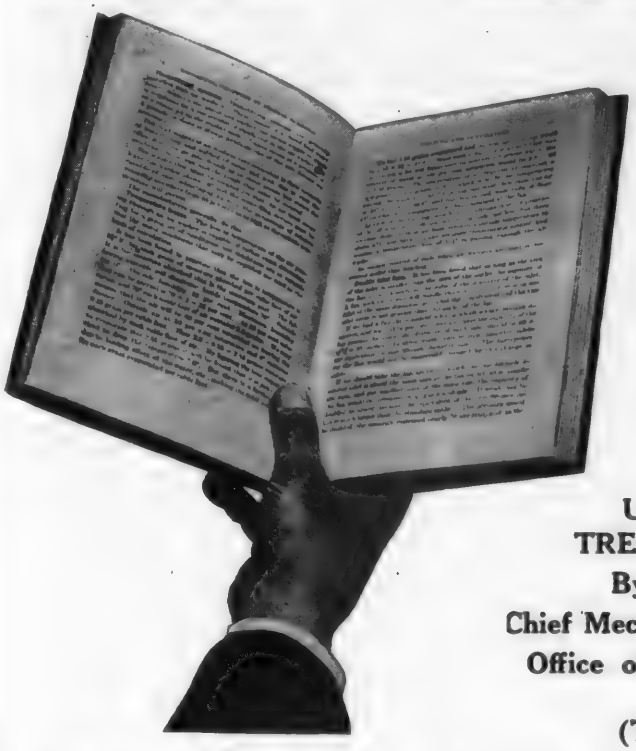

Mechanical Equipment of Federal Buildings

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This important work contains basic data used in the design of the entire mechanical equipment of Federal Buildings under control of the Treasury Department. In this third edition, the matter has been revised, amplified and extended to include an especially valuable chapter on "Operating Data of the Larger Federal Buildings" and another on "Small Refrigerated Water Drinking Plants." The data given for estimating the cost of the mechanical equipment of Federal buildings have also been extended and brought up to date.

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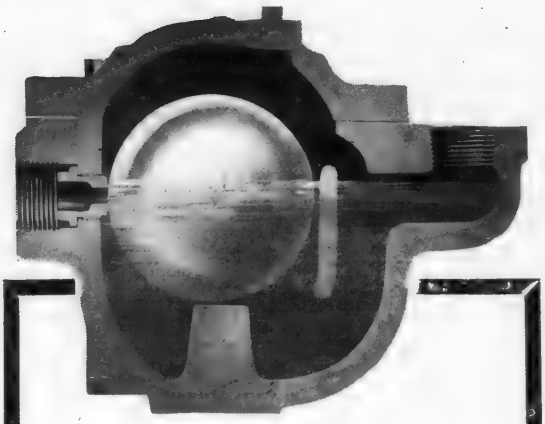

Low in upkeep—positive in action because it's simple —The J-M Steam Trap

It has no levers to break or strain—no valves to stick or clog—no screws to strip—no cotters to drop out—no adjustments necessary.

There is absolutely nothing in the make-up of this trap to get out of repair. It can't hammer, stick or air-bind. Its only moving part is a rolling ball—that's all. Discharge is continuous, as the condensation comes to the trap, not intermittent. Condensate rolls the ball up from the outlet nozzle, releasing water, air and gas at the same time. It is made in all sizes for all pressures.

Our nearest branch will answer all questions. Just ask them.

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New York City

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JOHNS-MANVILLE SERVICE
COVERS THE CONTINENT

jen, as district sales manager, and is equipped to make surveys of plants, to furnish plans, drawings, specifications and estimates, and to contract for condensers, centrifugal pumps, Alberger-Curtis steam turbines, Wainwright heaters, expansion joints, Hammond water meters and other power plant accessories designed and manufactured by this company.

Warren Webster & Co., Camden, N. J., announce the appointment of Eugene P. Bradley and Thomas J. Hester as St. Louis district managers of the company. A branch office will be maintained in the name of Warren Webster & Company, at 1212 Chemical Building, St. Louis. The announcement contains views of some of the more important building in St. Louis equipped with the Webster vacuum system of steam heating, including the St. Louis Cathedral, Missouri Botanical Gardens, Missouri State Capitol, Hotel Statler and Railway Exchange Building.

Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., announces that the plot of ground recently purchased at Essington, near Philadelphia, will form a new industrial center for the Westinghouse Electric interests. The site embraces about 500 acres, with a frontage of approximately one mile on the Delaware River. Additional transportation facilities will be afforded by tracks from the Pennsylvania and Philadelphia and Reading Railroads. This new center will be devoted to the production of large apparatus, the first group of buildings being for power machinery, principally steam turbines, condensers, and reduction gears. The initial development will cost in the neighborhood of $5,000,000 or $6,000,000, occupying about one-fifth of the area of the entire plot. The group will consist of the following buildings: two large machine shops, an erecting shop for heavy machinery, forge shop, pattern and pattern-storage shop, and power house. Work will begin on these as soon as satisfactory building contracts can be let. The number of employes to be engaged at the new plant has not as yet been definitely determined but will number several thousand people, and undoubtedly will in the future equal the number employed at East Pittsburgh, representing over 20,000 people.

Vapor Heating Co., Philadelphia, Pa., manufacturers of the Broomell system of vapor heating, announces that, owing to the great increase in its business and to facilitate the work of its service bureau, which is a feature of the Broomell system, the company has moved its general offices from Philadelphia to York, Pa. Under this new arrangement the manufacture, shipping and accounting depart-

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Here is a simple, sensitive, direct acting

High Pressure Steam Damper Regulator

which will automatically operate a balanced draft damper on a slight variation of steam pressure. Designed for boiler pressures from 15 to 175 lbs. Easily installed. No auxiliary mechanism. No hydraulic supply or waste lines.

All Metal. Dust Proof. Easily Adjusted. Graduated in Its Action. Guaranteed.

Send for Metaphram Circular.

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THE ⌐¬ SHAPE TUBES EXPLAIN THE SUCCESS

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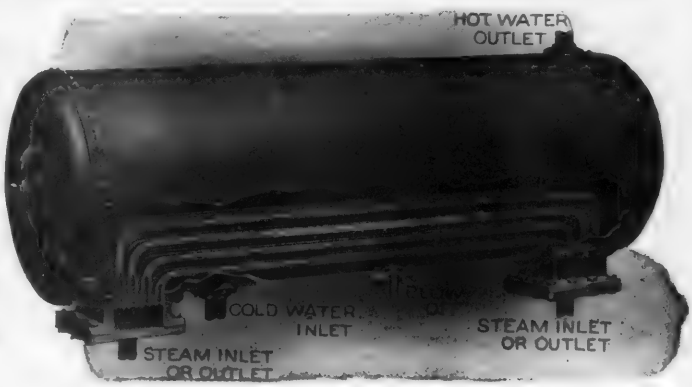
PATTERSON HOT WATER TANK

for heating water for domestic or manufacturing purposes. Both ends of each seamless brass tube are expanded into heavy cast-iron tube-heads with an improved roller expander. Their shape provides for the free contraction and expansion of each individual tube without straining, so there is no danger of leakage.



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See that this name is on your regulator.

It's a small precaution but it will prove a big benefit to you in service and satisfaction.

13160

The 13160 is an unsurpassed all around valve. It is exceptionally good but it is no better than any other Mueller valve.

Our line is complete. We have a particular type of valve for every kind of service.

Take the question up with us.

H. MUELLER MFG. CO.

Decatur, Ill.

NEW YORK
145 W. 30th St.

SAN FRANCISCO
589 Mission St.

ments will be under the direct personal supervision of A. P. Broomell, president, and William H. Koller, secretary. This will leave the local offices free to devote their entire attention to the engineering and installation work, and to give attention to the calls on the service bureau. Charles E. Scott, for the past ten years manager of the company's New York office, has been appointed general manager of the company, with headquarters in New York. He will retain direct personal supervision over the New York office. Charles F. Mau has been appointed local manager of the New York office, and E. M. Barker, who has been connected with the company since its inception as chief engineer, has been appointed local manager of the Philadelphia office. J. J. McKenna and J. Glassey are associated with Mr. Barker in the Philadelphia office. R. W. Farmer remains as local manager of the Boston office. The company is at work on a new catalogue which will soon be ready.

American Radiator Co., Chicago, Ill., has declared a dividend of 50% on the common stock, payable March 15 in new common stock. In addition a regular quarterly cash dividend of 3% was declared on the common stock outstanding March 21, payable March 31. As the cash dividend of 3% is payable after the payment of the 50% stock dividend, the cash dividend will apply to the increased issue, being the equivalent of a quarterly payment of 4½% on the old issue. The authorized common stock by this arrangement is increased from $9,000,000 to $22,000,000. The directors declared the regular quarterly preferred dividend of 1¾%, payable February 15.

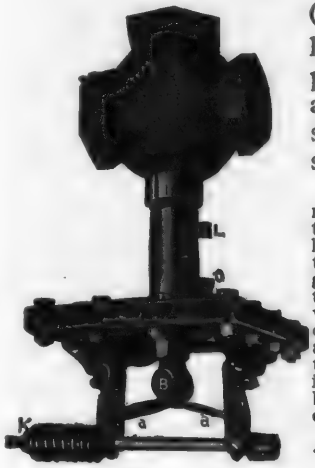
Holland, Mich.—The Home Furnace Company, recently capitalized at $40,000, has elected the following officers: President, George Kollen; vice-president, C. J. Lokker; secretary and manager, N. J. Yonker; executive committee: J. P. Huyser and C. J. Lokker. Half of the treasury stock, placed on the market with a 10-days' option at par for original subscribers, has been taken up.

N. & G. Taylor Co., Philadelphia, Pa., manufacturers of tin plate of all kinds, has been incorporated under the laws of Maryland as the N. & G. Taylor Co., Inc. The following officers have been elected: President, Hollinshead N. Taylor; vice-president, William W. Justice, Jr.; secretary-treasurer, L. Leslie Helmer. The company has been in business 107 years, always under control of the same family. The plant is located at Cumberland, Md., where extensions are now being made to increase the output.

For Safety, Sureness of Operation and Durability

FOSTER PRESSURE REGULATORS

for STEAM HEATING SERVICE



(Classes "Q" and "Q H") lead the way. Designed especially for steam heating, and suitable for vacuum systems, for delivery pressure of from 1 to 15 lbs.

We make several types of pressure regulators—those shown in the illustrations here were designed particularly for steam heating service, and they are very sensitive, reliable, high grade in every particular and superior to other makes in construction and workmanship. there are no weights or close fitting pistons, and are easily adjusted to the desired pressure between 1 and 15 lbs. Made in sizes ¾ inch to 2 inches inclusive, composition body. Larger sizes are fitted with composition renewable seats.

Class "Q" Class "Q H"

These Valves are fully explained on Pages 29 to 33 of our General Catalogue, No. 20.

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Fewer Ventilators Do Same Work

An Autoforce Ventilator will remove three times as much air as any stationary ventilator of the same size, and twice as much air as an ordinary swinging cowl ventilator. Therefore to handle the same amount of air, fewer ventilators are necessary, or else smaller sizes at less cost can be used.

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Autoforce Ventilator

is suitable for any requirement where an inexpensive, but effective method of removing foul air is required.

Very sensitive to wind pressure—will swing with the slightest draft. Transforms wind pressure into suction.

Easily installed—send for circulars and discounts.

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1123 Broadway, New York

Pierce, Butler & Pierce Manufacturing Corporation's meeting of its sales corps which, as announced last month, was held at the company's plant at Eastwood, near Syracuse, N. Y., was attended by some 84 representatives of the company. The principal addresses were made by Mayor Walter R. Stone, President J. T. Duryea, Sales Manager E. F. Glore, Treasurer J. B. Chambers, E. H. Giles, manager of the Philadelphia branch, who spoke on "Selling Ethics"; J. G. Kelly, of the New York office, who spoke on "Creative Sales"; E. A. Morris of the Boston office who discussed "Handling Customers"; and W. G. Shafer, manager of the Eastwood plant.

Kewanee Boiler Co., Kewanee, Ill., elected the following officers at its recent annual meeting: President, E. E. Baker; vice-president and treasurer, B. F. Baker, secretary, J. P. Dugger; manager, M. F. Moore; sales manager, H. E. Pursell; eastern manager, Homer Addams; assistant treasurer, W. D. Glidden. Board of directors: above-named officers and C. V. Kellogg, Chicago; C. A. Burton, Kansas City, Mo.; H. D. Cherry and E. F. Wagner, both of Kewanee. Following the annual meeting, a banquet of the officers, sales force and office force was held. The occasion marked the 25th anniversary of the organization of the company. In connection with the anniversary a presentation was made to President E. E. Baker and to Vice-President B. F. Baker of embossed silver tablets, the presentation speech being made by Secretary J. P. Dugger. A silver tray was also presented to M. F. Moore from the foremen of the boiler shop and allied departments. The Kewanee Boiler Company has recently purchased the plant of the Weil Boiler Co., in Indianapolis, Ind.

Detroit Valve & Fittings Co., Detroit, Mich., has opened a branch office in New York, in the Architects' Building, 101 Park Avenue. H. Romeyn Smith is in charge as eastern sales manager. The company is about to make a number of extensions to its plant at Wyandotte, Mich., which, it is stated, will increase its output 50%. When completed the company's plant will occupy nearly nine acres.

Kanawha Mfg. Co., Charleston, W. Va., manufacturer of the Bernhard heating boiler, is making another extension to its plant in the forms of two new factory wings, to take care of the increased space required for manufacturing purposes.

Spencer Heater Co., Hartford, Conn., announces the removal of its Philadelphia branch to more spacious quarters in the Otis Building, at 16th and Sansom Streets. M. C. Gillette, is manager.

Vapor-Vacuum Heating Co., Philadelphia, Pa., manufacturers of the Kriebel system of vapor-vacuum heating, announces that it is now located in its new home in the Otis Building, at 16th and Sansom Streets. This building is equipped with the Kriebel system, supplying 9,718 sq. ft. of radiation.

New Firms and Business Changes.

Carlos De Zafra, M. E. has resigned his position as sales manager of the Gas Engine & Power Co. and Charles L. Seabury & Co. (consolidated) and has been appointed manager of the Pittsburgh branch of the Telautograph Corporation. Mr. Zafra developed the field for the Seabury water-tube high-pressure boilers and also for the new type of Seabury water-tube heating boilers.

L. S. Shaw & Co., Dime Bank Building, Detroit, Mich., is the title of a new sales engineering firm which will specialize in power plant equipment. The head of the firm is L. S. Shaw who has had 15 years' experience in power plant design, construction and equipment, having been with the Consolidated Gas Company, New York; J. G. White & Co., and the Edison Co., of New York. For the past five years he has

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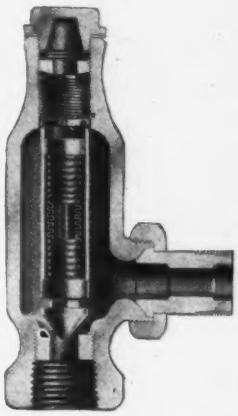

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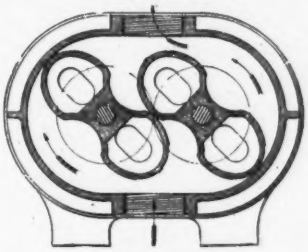

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THE OHIO BLOWER CO.
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been manager of the power department of the Westinghouse companies at Indianapolis, Chicago and Detroit. Mr. Shaw is a member of the National District Heating Association and has been a prominent figure at its conventions.

Norton & Spangler, Seattle, Wash., have taken over the heating and plumbing business of Norton & Smith. The principals are E. H. Norton and E. G. Spangler.

New Incorporations.

Miles Heating & Ventilating Co., Cleveland, O., capital $25,000, to engage in power, heating and ventilating engineering. The firm will take over the local business of the McGinness Co., of Pittsburgh. The president of the new company is J. C. Miles, formerly Cleveland manager for the the McGinness Company. Other incorporators are: G. W. Cornelius, C. M. Miles, A. D. Partenfelder and M. E. Corrigan.

Phelps Boiler Corporation, New York, capital $50,000, to manufacture heaters, stoves, radiators and accessories. Incorporators: D. J. Dowling, C. S. Ashley and H. J. Neushafer, 1515 Woodhaven Ave., Queens.

Richard H. Johnson Co., Ocean City, N. J., capital $25,000, to conduct a heating and plumbing business. Incorporators: Richard H. Johnson, Viola G. Johnson, Ocean City; and George W. Patton, Philadelphia.

Spohn Heating and Ventilating Co., Cleveland, O., capital $20,000. Incorporators: E. M. Golding, A. C. Wald, Wallace L. Schambs, M. E. Balcom and M. R. Burridge.

Radiant Heater Co., Cleveland, O., capital $60,000. Incorporators: J. Harris, A. H. Brainard, Robb O. Bartholomew, Edward W. Leeper and Ira E. Arnold.

James D. McEntee Heating and Plumbing Corporation, New York, to conduct a heating and plumbing contracting business. Incorporators: V. J. Muller, M. E. and J. D. McEntee, 475 West 159th Street, New York.

E. Della Plumbing Co., Rochester, N. Y., capital $10,000, to engage in the heating and plumbing business. Incorporators: C. and J. Marconti and E. Della.

St. Louis Ventilating and Sheet Metal Co., St. Louis, Mo., capital $3,000, to conduct a general sheet metal business. Incorporators: A. J. Schmittner, F. J. Kettenbach and M. A. Kettenbach.

Wilson Wholesale Plumbing Co., Wichita, Kan., capital $30,000. Incorporators: W. H. Wilson, Ralph Hendrick, Howard Wilson, Fred Newcomb and C. N. Williams.

Ford Brass Co., Springfield, Mo., capital $10,000. Incorporators: H. T. Ford, J. J. A. Gammon, E. V. Ford and T. M. Ford.

Lytton-Wood Engineering Corporation, Norfolk, Va., organized to manufacture heating specialties. The new company has taken manufacturing quarters at 117-119 Chestnut Street, Norfolk. President, J. W. Lytton; secretary-treasurer, R. B. Wood.

Contracts Awarded.

Seattle, Wash.—Bids were received as follows for the heating, ventilating and plumbing of the Youngstown School, Seattle, and the heating and ventilating of the West Seattle School: Youngstown School; (a) heating and ventilating, (b) plumbing: F. C. Helenthal, (a) $11,580; Eckart Plumbing & Heating Co., Seattle, (a) $11,685, (b) $10,405; D. H. King, Seattle, (a) $11,692; (b) $10,160; P. J. Lavan, Seattle, (a) $11,925; Dupar Bros., Seattle, (a) $12,345; W. D. Allen, Seattle, (a) $11,800; Norton & Spangler, Seattle, (a) $12,250, (b) $10,650; Wenzler & Ward, Seattle, (a) $12,687, (b) $10,310; Whipple & Co., Seattle, (b) $10,020. West Seattle School, Heating: Dupar Bros., Seattle, $42,700; F. C. Helenthal, Seattle, $43,080; Wenzler & Ward, Seattle, $42,620.

Wanted.

Open for Engagement.—Heating engineer, experienced estimator and superintendent. Can make layouts and specifications for all kinds of steam, vapor, vacuum and hot water heating systems. Position with large installing firm or with manufacturer as salesman desired. Address Engineer, care of Heating and Ventilating Magazine.

Wanted.—A good heating and ventilating engineer. One who is at present employed preferred. Must give good references as to his commercial and engineering ability and state salary expected. Address Moline Heat, Moline, Ill.

Wanted.—Estimator and draftsman on steam, power, heating and ventilating work. Apply by letter, stating experience and salary expected. Address G. H., care of The Heating and Ventilating Magazine.

The Heating and Ventilating Magazine

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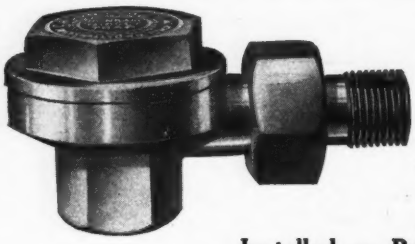

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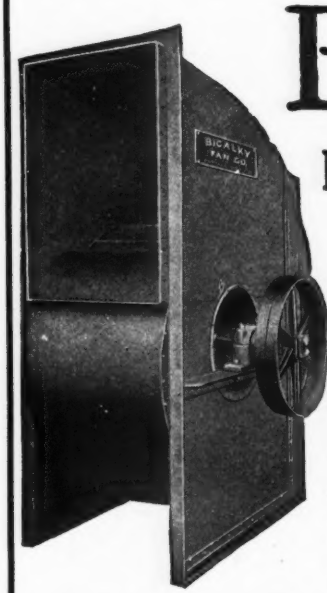

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